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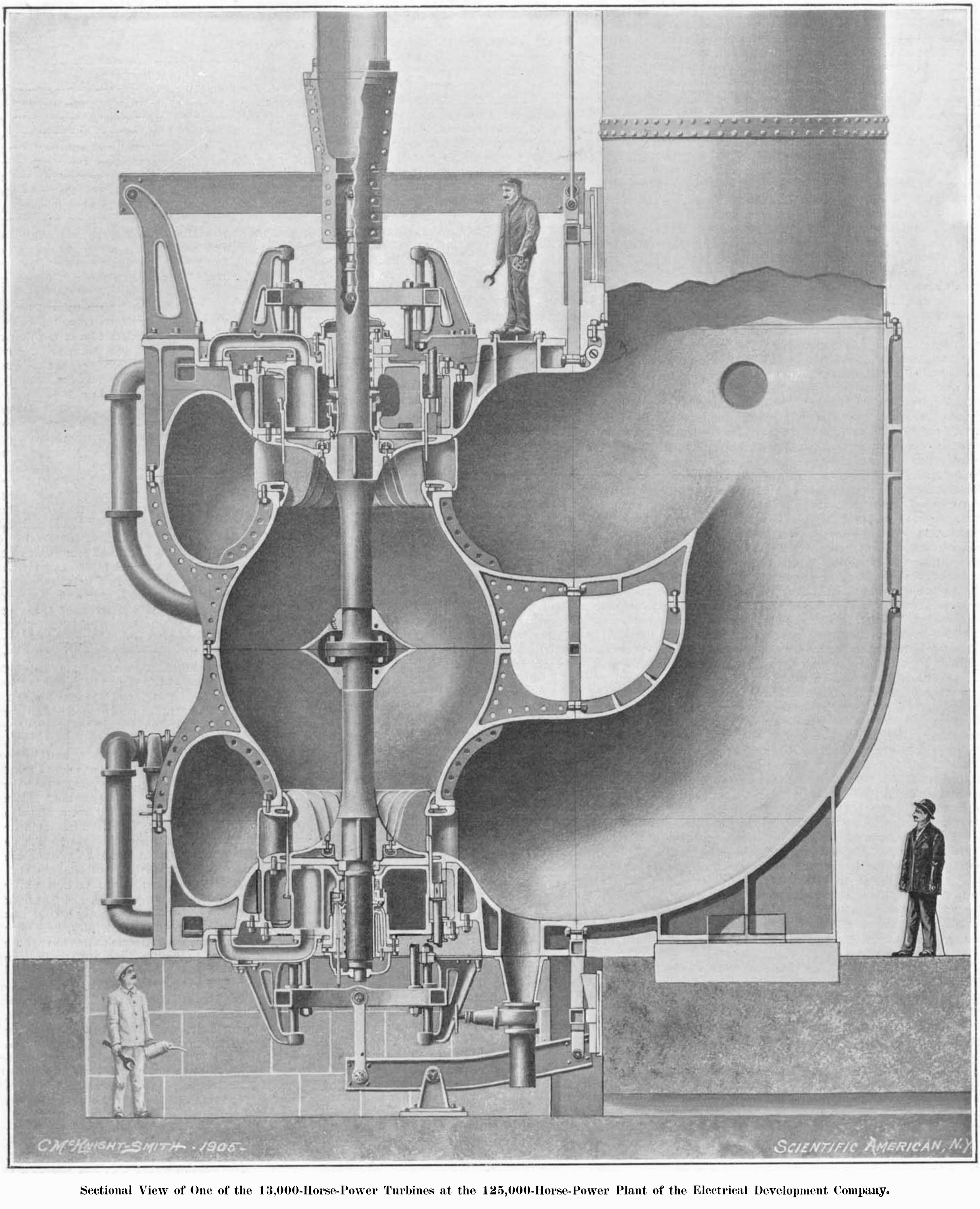

Sectional View of One of the 13,000-Horse-Power Turbines at the 125,000-Horse-Power Plant of the Electrical Development Company.

ELECTRIC POWER DEVELOPMENTS AT NIAGARA FALLS.—II.—[See page 320.]

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NEW YORK, SATURDAY, OCTOBER 21, 1905.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE SINGLE-PHASE SYSTEM IN AMERICA.

The electrical engineers who have been investigating the question of the best system of electric traction to be adopted on the suburban and terminal lines of the New York, New Haven & Hartford Railroad, in New York city, have recommended the use of the single-phase alternating-current system. This is the most important step that has yet occurred in the introduction of single-phase alternating-current traction in this country; but it is fully justified by the results which have already been attained in the first two electric roads to be operated with the single-phase current in America.

It is fortunate that the two interurban trolley roads upon which the single-phase alternating-current motor has been installed, perform a service that is broadly different in its requirements. The first of these is a high-speed line, built between Indianapolis and Rushville for the operation of heavy interurban cars at high speed. The considerations in the construction and equipment of this road were, that the roadbed and track and cars must be of thoroughly solid and first-class construction, and that a large amount of energy must be delivered to each car. On the other line, known as the Pontiac-Odell line, the speed is relatively low and the cars relatively light and the track of moderate cost, the road being built through a sparsely-settled country, in which it was necessary to keep down the cost of construction, if the system was to be operated at a profit. The high-speed Rushville line was opened at the commencement of the year, and the Pontiac line three months later, and on both roads the single-phase alternating-current motors have done everything that was demanded of them. There has been an absence of troubles from sparking and overheating, while the sliding contact bow trolley on the high-speed line has, contrary to expectations, given but very little trouble in the nine months of its operation.

In view of these facts, the announcement that the important work of equipping the New Haven system is to be carried out on the single-phase system is not surprising. The electrical equipment will be furnished by the Westinghouse Electric and Manufacturing Company; and it is interesting to note that the electrical equipment of the New York Central's lines, which is being provided by the General Electric Company, is of the direct-current type. The New York Central Company considered, at the time that they decided to adopt the direct-current system, that the alternating-current motor and its accompanying equipment had not been sufficiently long under test to warrant their applying it on the great scale that was contemplated on their lines. Since that decision was taken, however, the practical experience that has been gained with high-tension systems, both abroad and in this country, has established beyond a question the reliability, and other advantages, of the later type.

The advantages that led the New York, New Haven & Hartford road to adopt the single-phase system are, that it dispenses with costly rotary converter sub-stations; that it greatly cheapens the line construction; that it enlarges the radius of action from a single power station; that it possesses great flexibility; and that it presents attractive features of economy and exactness in speed control. Another feature, of great importance in terminal work such as this, is the fact that the high voltage renders it possible to use the overhead line, and get rid of the many complications and dangers that would be involved in the use of the third rail in the terminal yard.

The contract for equipping the New Haven road includes twenty-five 78-ton electric locomotives, each capable of maintaining a schedule speed of 26 miles per hour with a 200-ton local train, making stops every 2.2 miles. The same locomotives will be capable of hauling 250-ton express trains at a speed of from 60 to 70 miles an hour, two or more locomotives being coupled up for heavier trains, and operated by a single engineer through the multiple control system. A valuable feature of the Westinghouse single-phase alternating-current motors is that they will operate successfully with direct current; consequently, the trains can be run over the New Haven tracks as far as Woodlawn under the alternating current, and from Woodlawn to the Grand Central Station they can draw upon the direct current through the third-rail conductors used by the New York Central.

OUR TWO GREAT CANAL PROJECTS.

At the present time the United States has under construction two great engineering works which, in point of magnitude and cost, far exceed anything under construction or projected elsewhere. One of these is being carried out by the Federal government, the other by the enterprise of a single State, and each is destined to exert a widely-extended influence upon the commerce not merely of the country and state affected, but of the whole world. We refer to the 46-mile ship canal which is to be opened across the Isthmus of Panama, and the 350-mile barge canal which is now being built across the State of New York. The Federal project, for many reasons, looms so large in the public eye that the general public, and probably the majority of the people in the State in which the Erie barge canal is being built, will be surprised to know that in the mere magnitude of the work to be done the New York canal exceeds that at Panama. Furthermore, it is due only to the fact that the unit prices that must be paid for work at Panama are so much higher than those for work done at home, and in a temperate zone, that the cost of the Panama project will exceed that in New York State, although the latter will reach the great total of $101,000,000. This comparison, it must be understood, is based upon the project for a 68-foot summit level canal at Panama, which was the one in contemplation and under construction at the time the canal was taken over by the United States government. If the attempt be made to cut the canal at sea level, all the elements of time, quantities of excavation, and cost will be so greatly augmented, as to place the Panama enterprise beyond comparison with the barge canal.

At present, however, if the State and Federal canals are compared on the mere basis of quantity to be excavated and masonry and dams to be built, the remarkable fact is established that the completion of the Erie barge canal on the present plans calls for more work than the completion of the canal at Panama. We mention this fact as suggesting that the magnitude of the New York State project is little appreciated, not merely by the general public but by the people of the State that it concerns. The present Erie canal is about 350 miles in length, and the new canal follows the old location for only about 100 miles. The other 250 miles is laid out on what is practically a new route, and the change of location is explained by the fact that while the original canal clings to the lower slopes of the hills, well above the rivers, the new canal is located in the valley bottoms, and follows largely the rivers and lakes. It is an historical fact of no little interest, that the location of the new canal is laid very largely on an old route of travel by water, which was used by the pioneers who settled the western part of the State. When the Erie canal was built, as far as possible it avoided these water courses, but the new barge canal will follow them with but slight deviation. The water route followed by the early pioneers lay up the Mohawk River, which was followed to the neighborhood of Rome. Here a portage was made to Wood Creek, which was navigated to Oneida Lake. After crossing the lake the route lay down the Oneida River to the junction of the Oneida with the Oswego and Seneca rivers at Three Rivers Point. If from this point the traveler were bound for the settlements in the western part of the State, he would follow the Seneca River; or if he were making for Canada, or the far West, he would follow the Oswego River to Ontario, and continue his journey by the Great Lakes.

The new Erie canal follows the Hudson River to Waterford; then passes by locks to the Mohawk River above Cohoes Falls. From the Falls to Rome the bed of the river is utilized, the river being canalized. Beyond Rome there is a summit level connecting with Wood Creek, and the canal then continues over the old pioneer water route up the Seneca River to the vicinity of Clyde. From Clyde the new canal will follow the route of the present canal to the Niagara River at Tonawanda. Of the other two branches, the Oswego barge canal leaves the Erie canal at Three Rivers Point, and utilizes the canalized Oswego River to Lake Ontario. The new Champlain canal will not parallel the Hudson River on the bank of the same as at present, but will utilize the river itself from Waterford to Fort Edward, and from Fort Edward to Lake Champlain the present location will be followed.

The estimated cost of this great work, as we have said, is $101,000,000, and the whole plan of the work has been laid out to accommodate a tonnage of 10,000,000, while at a slight increase in cost, accommodation can be provided for a very much larger tonnage. The commerce of the upper Great Lakes is between 90 and 100 million tons per year, and the importance of the canal lies in the fact that it will provide a means for connecting this huge commerce with the seacoast by a direct route, on which freight can be carried at a cost below that which is possible on the railroad. The original canal had a depth of 4 feet, and accommodated boats of only 80 tons capacity. In 1835 it was enlarged to take boats of 240 tons. Then in 1894 came the agitation for deepening to 8 feet draft, instead of 6 feet, and the absurdly inadequate appropriation of $9,000,000 was made for doing this work. The present scheme, which owes its success not a little to the efforts of President Roosevelt when he was Governor of the State, provides a 12-foot depth throughout and locks of sufficient length to take two 1,000-ton barges at one lockage, which is about eight times the capacity of the present canal.

VANDERBILT CUP RACE.

The second annual contest for the International Automobile Cup presented by W. K. Vanderbilt, Jr., was run off on October 14 under conditions and with results that render it in some respects the most successful of the great annual international automobile races of recent years. In the first place, the weather was ideal. Cloudless skies, a moderate temperature, and the gentlest of breezes presented conditions that were ideal both for the contestants and for the many thousands of people that flocked to the Long Island race course. Then, again, a soaking rain that occurred a few days prior to the race, coupled with a second heavy oiling of the track, had brought the road into first-class condition, the surface being smooth and well compacted, and the dust absolutely laid.

Of the twenty machines that were entered for the race, eighteen started promptly on time, the one absentee being a 90-horse-power Mercedes of the German team. The first to get away was that veteran driver Jenatzy in his 120-horse-power Mercedes, and the other eighteen contestants were sent away at one minute intervals, the last of these, Sartori, in a 90-horse-power Fiat, flashing away from the mark at exactly eighteen minutes past six. So terrific was the speed cut out by the leader, that 6 minutes and 52 seconds after Sartori started, Jenatzy was seen a mile up the road from the grand stand, sweeping around the curve and straightening out for the long tangent to Jericho, upon which the highest speed of the day was to be made. He swept by the grand stand amid thunders of applause at a speed of 80 miles per hour, having made the first round of 28.3 miles in the remarkable time of 24 minutes and 52 seconds. The next competitor sighted from the grand stand was that brilliant driver Lancia, of the Italian team; and fast as was Jenatzy's time, Lancia had cut it down by 1 minute and 3 seconds, his time for the round being 23 minutes and 49 seconds. The lead obtained by Lancia was held and steadily increased in the succeeding rounds with mathematical precision, the first seven rounds being run at an average speed of 69.97 miles an hour. At the end of the seventh round he was 24 minutes and 28 seconds ahead of the third man, Hemery, and 21 minutes and 7 seconds ahead of Heath, the cup winner of last year, who was again driving a Panhard car. It was conceded at this time that, barring accident, the wonderful Italian driver would probably win by fully half an hour from his nearest competitor. But it was not to be. On his eighth round he had tire troubles, and after adjusting these, in turning onto the course ahead of Christie, he failed to give the latter sufficient room, and a collision occurred, in which Christie's machine was smashed and his mechanic seriously hurt, while Lancia's machine was so crippled that it took him 1 hour, 11 minutes, and 17 seconds to complete the eighth round. At this time, Hemery was leading with an elapsed time of 3 hours, 39 minutes, and 59 seconds, Heath being second, Nazzaro third, Szisz fourth, Tracy, in the 120-horse-power Locomobile, fifth, and Lancia sixth. The Italian made desperate efforts to regain his lost position, but he had to be content with fourth place at the finish.

The race was won by the Frenchman Hemery in an 80-horse-power Darracq, in 4 hours, 36 minutes, and 8 seconds, his average speed for the whole race being 61.49 miles per hour, which is about 9 miles an hour faster than the time made last year. Heath was second in 4 hours, 39 minutes, 40 seconds—an average speed of 60.71 miles an hour; and Tracy was third in 4 hours, 58 minutes, 26 seconds, which corresponds to an average speed of 56.90 miles an hour. The fastest lap was made by Lancia on his fourth round in 23 minutes and 18 seconds, an average speed for the lap of 72.87 miles per hour. A deplorable accident that removed one of the most promising contestants was the collision of Foxhall Keene, who was driving a 120-horse-power Mercedes, with a telegraph pole when making the difficult turn at Albertson. The smash placed him entirely out of the race, at the time when he was holding third position, on the sixth round.

A TEMPERANCE MATCH.

BY GEORGE S. HODGINS.

It may seem extraordinary, but it is nevertheless strictly true, that so innocent an article of domestic use as an ordinary sulphur match may be made apparently to exhibit a most marked antipathy to alcoholic stimulants of various kinds. The ordinary wooden match does not protest by word of mouth, nor does it burst into the indignant flame of protest, when brought in contact with spirits. Under certain circumstances, however, it will act with great promptness in placing itself as far as it can beyond the reach of the obnoxious stimulant.

The conditions under which a match may be made to show its temperance principles are readily obtained. If it be thrown upon the surface of some pure clear water, contained in a bowl or soup-plate, it will be ready for trial. For the sake of definiteness let us call the head of the match that end to which the red phosphorus mixture has been applied; and the other end we will here call the tail. If, as the match lies motionless upon the surface of the water at or near the center of the containing vessel, we take a minute drop of undiluted whisky or other strong spirit, and carry it upon the end of a knitting needle, and drop it upon the tail of the match, we will see that the match will instantly move off briskly in the direction toward which the head was pointing. It will probably only stop when it strikes the side of the bowl. We can now drive the match back again to the other side of the bowl by the addition of another drop from the decanter. In fact, the match may be driven back, forward, sideways, or given a circular motion, in accordance with the portion of the match to which we apply the stimulant. In all cases the match will certainly move away from the whisky. It will always endeavor to free itself from the influence of alcohol. It will remain true to its temperance principles under all these conditions. One point, however, that is well worthy of notice here is that it is not necessary to actually touch the match with the drop on the knitting needle. It is sufficient to deposit the drop on the surface of the water, but quite close to the match, and it will act as readily and quickly as if it had been touched.

It may be, as our investigation proceeds, that we shall find that the desire to escape from the alcohol is not entirely to be attributed to the temperance proclivities of the match itself. In fact, the match may not have any real connection with the cause which produces its motion. A little piece of paper folded down the center and touched at one end may be made to move as the match has done, in the case before us.

Another fact which directs us to look further for the cause of the phenomenon is that a scientific toy has been made in the form of a miniature boat. In this boat a small space at the stern when filled with ether or other liquid readily mixing with water, and discharged through a small hole, covered with a piece of linen, will cause the boat to move forward as long as this novel method of using "fuel" continues.

From these experiments with match and paper, and from the action of the miniature boat, it is evident that it is to the water and the alcohol or ether that we must look for the explanation of the apparent mystery.

The surface of clear, still water is a film stretched and tense, like the head of a drum. This may be proved by slowly and carefully filling a tumbler so that as the water rises in the glass the surface may be kept still and without tremor. If the water be poured in steadily and in small quantity, the level of the water may be made to rise above the top of the tumbler. The edge of the liquid will bend down to meet the glass all the way round. The tumbler may thus be made to hold more water than its actual cubical contents would amount to. The overfull tumbler may even be carried from place to place, if no sudden jar or tremor ruptures the enveloping film or skin. This film is of infinite thinness, but it is in no way a scum upon the surface. It can be instantly broken and it will instantly reform. It is always there, pulling equally in all directions, and doing so all the time. Now this film, common to all liquids, has a definite amount of tension. It varies in different liquids. In some it is greater, and in some less, but the films of all liquids have a certain amount of surface tension.

When the match floated on the water, it was lying in this surface film, and as the film was pulling it equally in all directions, no motion was possible. When the drop of alcohol was placed upon the film of water at the tail of the match, the alcohol spread out for a moment, and formed also a film of exceeding minuteness, but with less tension than that of the water. Taking the place of the water film at the tail of the match, it destroyed its tension, and the pull of the film at the head of the match drew it rapidly away from the less powerful pull applied by the alcohol. There was momentarily a tug of war game played with the match, by the water film at the head, and the alcohol film at the tail, with the result that the water film, being the stronger, pulled the match away from the spirit. When the alcohol had mixed with the water, the normal surface tension of the latter being restored, the match was again acted upon by a balanced pull in all directions. So also in the case of the little boat. Its motion resulted from the continuous release of surface tension behind, and the pull, upon the bow, of the stronger tension of the film in front. The pull upon each side, in opposite directions, being balanced, no side motion was possible.

Another very curious but simple experiment, which illustrates the differing surface tensions of various liquids, may be made with the bowl of clear water. If, upon the surface of the water you place a small drop of coal oil, you will find that the oil slowly spreads out in a circular patch. If upon this circle of coal oil, a minute drop of alcohol be placed, the circle will be instantly destroyed, and the oil will tremulously break up and fly outward in all directions over the surface of the water. If you are fortunate enough, as is sometimes the case, to succeed in having the drop of coal oil remain without spreading out, it will lie on the surface of the water, forming a minute flattened globule, very much in shape like an ordinary magnifying glass, more correctly described as in the form of a bi-convex lens, and the experiment will be more interesting. If upon the lens of coal oil floating on the water, a small drop of alcohol or pure whisky be placed, it will remain for a moment in apparent rest, glistening on the top of the oil lens. As you watch, the whole will, all at once, with a sudden quiver, break up, the alcohol disappearing, while the coal oil globule, as it were, explodes, and scatters its particles outward in all directions.

The coal-oil globule floated upon the surface film of the water, which it did not break, just as a needle may be made to float upon the water, for the selfsame reason. The globule of alcohol stood there momentarily, and the oil just then resisted it. As the alcohol, with its feeble surface tension, sank upon the oil, it destroyed the tension of the film forming the oil's upper surface. The pull of the lower oil surface, resting unbroken on the water, was greater than that of the oil and alcohol-permeated upper surface; the upper surface consequently ruptured, while the tense under side of the oil rolled it over and under, and flung the oil outward in all directions, with a miniature convulsion. The alcohol and water mixing left the oil particles scattered and detached, outside the area of disturbance. The whole oil globule, with both surfaces in tension, had had its upper surface broken into by the alcohol, and the unbalanced pull of the underside film destroyed it in a moment, as if by magic.

THE SIZE ILLUSION OF THE DEPRESSED LETTER P.

BY DR. J. E. WALLACE WALLIN.

The illusion consists in the apparent transformation of the capital P into a lower-case p when it occurs depressed in the line. The illusion quantum is independent of the position of the P in the word, as seen in the following examples:

Prin	PaPas	PriP
prin	Papas	Prip

It does not seem to be increased by still farther lowering the P, nor by lengthening the word, nor by being placed in juxtaposition to capitals instead of lower-case letters. Indeed with some capitals the result of the latter expedient is to diminish its strength. The illusion does not occur with other capitals whose lower-case letters are similar, namely: C, O, S, U, V, W, and X.

On first blush this would seem to be an instance of a psychological illusion, an illusion of assimilation. The loop in the P assimilates with the contiguous letters when placed on a level with them, the psychological law being that when the differences between compared extents are small the extents assimilate and seem equal, and when the differences are pronounced they contrast and appear more pronounced. But the width of the loop is no wider, in the above examples, than the top of the r nor the bottom of the a; and, in the following examples, the illusion is magnified rather by contrasting with a larger extent (O, which is longer than the loop and slightly wider) than by assimilating with a smaller one (i, here, however, the difference is so pronounced that the illusion might, rather, be considered to follow the law of contrast, whence P should appear enlarged and the illusion weakened):

iiiPiii	OOOPOOO
iiipiii	OOOpOOO

It appears, then, that the illusion occurs: (*a*) in situations offering no motives for assimilation or contrast (the best example, perhaps, is with the lower-case o); or (*b*) in those offering either motive. Hence these two motives can, at best, play only a subsidiary rôle.*

The illusion is, perhaps, only another case of the illusion of the vertical. We may assume that the average level of the line of regard in traveling over the line of print is near the upper edge of the preponderant letters (which, indeed, certain experiments indicate). When the letter P, therefore, is in its normal position the eye is obliged to deviate in the vertical direction in order to project its important parts upon the macula; and a vertical movement amounts to an exaggerated judgment of height. The actual process, of course, may be simply a motor tendency or an association. At the same time, the situation allows two co-operating factors: the law of perspective, according to which the high ground appears more remote, which, with optical impressions from identical distances, amounts to exaggerated size; and the fact that the depressed P extends below the lower line of the lower-case letters, exactly as in the case of the lower-case p. This association may in itself be so strong as to lead the judgment astray. That it is a factor may be proved by elevating the lower-case p: Prin / Prin˙

Here the force of the illusion, however, is somewhat lessened, which may be due to the conspicuousness of the marks distinguishing the two fonts above.

* On the Helmholtzian assumption the loop is more separate and distinct when the P is in its normal position. Its size is therefore overestimated.

SCIENCE NOTES.

A word may be said concerning the regeneration phenomena which are strikingly characteristic of the lower groups of plants, but which in the higher plants do not seem to be well emphasized, and are certainly less understood. The regeneration of the root tip has been best studied. In none of the higher plants has it been possible from a single isolated active non-sexual cell, or a small group of cells, to regenerate the plant.

The discovery by Millardet about twenty years ago of the remarkable fungicidal value of Bordeaux mixture was the starting point of the scientific and practical development of the use of fungicides, and has resulted in a very wide use of the compounds of copper for the purpose of preventing plant diseases. Several destructive diseases of potatoes, such as early blight and late blight, or potato rot, which often cause great loss to the growers of this crop, are now easily prevented by spraying the plants with Bordeaux mixture; and by adding a little Paris green to the mixture protection is afforded by the same treatment against the ravages of the potato beetle. The black rot and brown rot of the grape, which at one time practically destroyed the grape industry of the Central and Eastern States, have been carefully investigated and an effective remedy found in Bordeaux mixture. In fact, this mixture, which is a combination of copper sulphate and lime, has been found an effective protection against the larger number of parasites which attack plants through the leaves, stems, or fruit.

We desire to know much more concerning the individual planets. Everybody asks: "Are the planets inhabited?" and no favorable answer has yet been given. If one means by the question, inhabited by such beings as we are structurally, then one can say that if one of us were transported to any of the planets we could not live there a minute. Some, like Jupiter, are too hot; others, like the moon, too cold, or without air to breathe or water to drink, or with too great or too little gravity for our bodies. One does not need to assume such likeness, especially since we know something of the past history of man and animals on the earth, adapted to it in form, size, structure, habits and intelligence all correlated. To assume intelligence of our type is hardly allowable any more than for structures like ours. Vertebrate skeletons are not necessarily the only form in which intelligence of high type may abide. The implements and skill of astronomers are yet to determine what can be learned about this question. Taking what we know about the development of life on earth, it would seem to be insanely improbable that, among the millions of millions of huge bodies in the universe, all apparently made of the same kinds of matter and subject to the same laws, the earth is the only one among them all to have life and mind developed upon it. But at present we do not know that it may not be true. Let the twentieth century find out.

Innumerable storage reservoirs and vast distribution systems for supplies of pure water bear witness to the enormous debt which public health science owes to engineering science, as do proper street construction and, still more, those splendid systems of sewerage with which so many modern cities are equipped, and which not only serve to remove quickly the dangerous liquid waste of human and animal life, but also keep low and wholesome the level of the ground water, reducing dampness and promoting dryness of the environment, and thereby strengthening that physiological resistance by means of which the human mechanism fights against the attacks of infectious disease. Nor do the services of engineering science end here, for the fluid content of the sewers must always be safely disposed of, and sewage purification is to-day a problem of engineering science no less important or difficult than that of water purification. These same processes of the purification of water and sewage are matters of so much moment in public health science that in almost every country experiment stations are now maintained at public and private expense for the purpose of working out the most practical and most scientific methods of purification.

THE DUFAUX FLYING MACHINE.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

The experiments which were recently made at Paris with the new Dufaux flying machine seem to prove that a considerable step in advance has been made in this direction. Up to the present we can scarcely point to an apparatus which is able to rise in the air by the force of its propellers alone, driven by a gasoline motor, and carry a reserve of energy necessary to continue its flight in the air. Such a machine has been built by two young engineers of Geneva, Henri and Armand Dufaux, who are already known by their invention of the motosacoche, or gasoline motor outfit applied to a bicycle. After working for some time, they have succeeded in building a *helicoptere*, or "propeller flier," which will rise in the air as long as there is any gasoline in the reservoir, and the supply can even be increased, seeing that the flier will carry a dead weight of 15½ pounds outside of its own weight, which is 38½ pounds. At the Aero Club it is considered that the Dufaux apparatus will no doubt aid greatly in solving the difficult problem of the "heavier than air" type of flying machines.

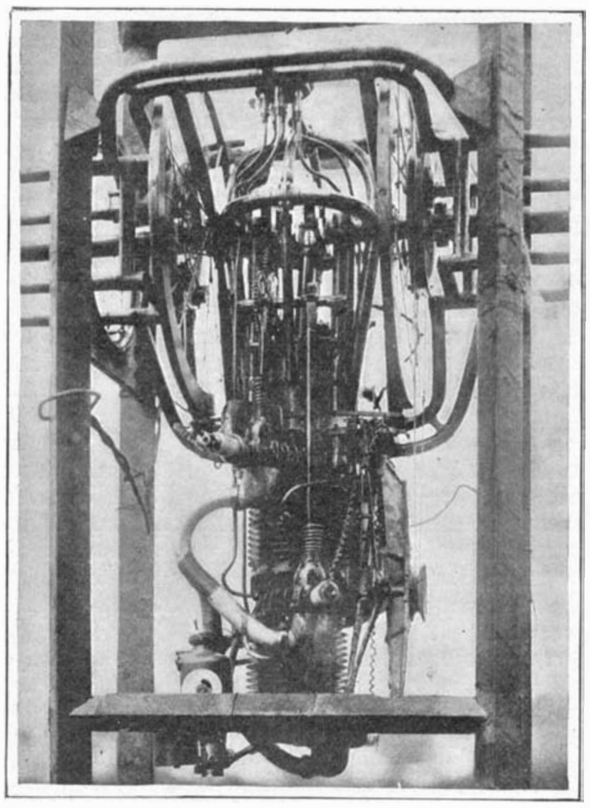
The complete apparatus is represented diagrammatically in the accompanying drawing, showing the arrangement of the propellers, *H H H' H'*, carried by the steel tubular frame, *B B'*, and driven by the motor, *M*. The extensions of the frame are hollow rods, *A A'*, carrying at each end two plane silk surfaces, *S S S' S'*, placed above one another and affording a total surface of 11 square meters (118.4 square feet). The triangle, *A*, is a rudder fixed in front of the apparatus. The total weight of the whole outfit is only 23 kilogrammes (50.7 pounds).

In order to insure the stability of this combined flying machine, the longitudinal axle, *A A'*, is made free to rotate round the transverse axis, *B B'*, and the point of application of the motive force, that is to say, the crossing of the axes, *A A'* and *B B'*, is nearer to the front aeroplanes, *S*, than to the rear aeroplanes, *S'*. The motor, *M*, and the dead weight, *N*, moreover, are always kept vertical under the influence of gravity, while the axis of rotation of the screws may be inclined with regard to the motor until they become horizontal.

As constructed at present, the apparatus is intended simply to demonstrate the principle which the inventors are bringing out. Once this point is proved successfully, the next step will be to build a complete flying machine of 100 horse-power. One of the interesting points about the apparatus is the motor, which is claimed to be a step in advance in the way of gasoline motors for flying machines. It has been specially designed for the purpose by Messrs. Dufaux, and is of the two-cylinder, air-cooled type. One of the views shows the motor along with the different parts of the transmitting mechanism. The motor is of the double-acting type. It has two superposed cylinders having a combustion chamber at each end and one between the two. The three inlet pipes from the carbureter, which is a new one of the constant-level type, can be seen in the cut of the motor, as well as the three separate spark plugs for the ignition. The carbureter is placed at the bottom of the motor on the left. It is especially light, being made of aluminium and copper. The high-tension ignition current is produced by a single Dufaux induction coil with vibrator. This current is commutated to the different spark plugs. On the right is a fan with vanes made of wood frames covered with silk. It is driven from the motor shaft above, and has a good effect in cooling the cylinders. The gasoline reservoir is formed of two aluminium caps which are soldered together.

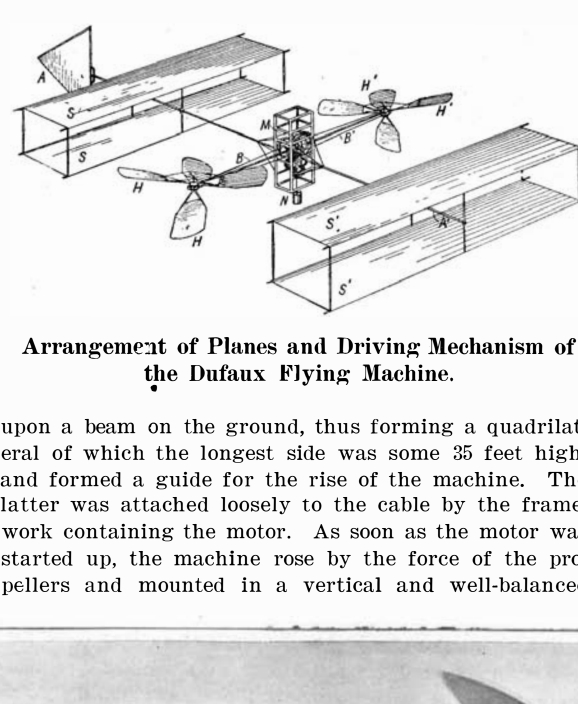
One of the main ideas has been to make the motor as light as possible, and most of the different parts, such as the valves, rods, and shafts, are made hollow. In this way the inventors have succeeded in building a motor which weighs only 4.5 kilogrammes (10.1 pounds) for an output of 3 1-10 horse-power at 1,500 revolutions per minute. The weight given above includes the carbureter, gasoline tank, piping, flywheel, and all the working parts, and is quite a remarkable result in the way of a light gasoline motor, as it means a weight per horse-power of only 3.3 pounds.

A speed of 250 revolutions per minute is usually given to the propellers. Each one weighs 450 grammes (1.01 pound). The method of constructing them is claimed to be one of the best which has yet been found for securing lightness and rigidity. The frames are made of thin strips of pine wood assembled together and fastened to the silk by gluing. The curvature and pitch of the propellers were modified after different experiments until the inventors reached the best results as to power, combined with a good equilibrium.



The Motor of the Dufaux Flying Machine.

The tests of the new apparatus were made at the large balloon shed of the Aero Club, in the suburbs of Paris. An endless cable was mounted so as to run upon four bicycle wheels, two in the ceiling and two upon a beam on the ground, thus forming a quadrilateral of which the longest side was some 35 feet high, and formed a guide for the rise of the machine. The latter was attached loosely to the cable by the framework containing the motor. As soon as the motor was started up, the machine rose by the force of the propellers and mounted in a vertical and well-balanced flight up to the roof of the shed, which was as far as it could go, as it was retained by a trail-rope. In the open air, there is no doubt that it would have risen to a considerable height. This experiment was made several times, with equal success. Many experienced aeronauts, and especially those who are interested in the aeroplane method, were present, and they were greatly impressed with the way the new machine acted. As at present constructed, the apparatus is only one part of a complete flying machine and will be used for the lifting movement. Afterward the inventors are to add an aeroplane which will provide for the horizontal movement. Messrs. Dufaux are now engaged in building a complete aviator on the same lines, but this is to be a large machine and will carry an aeronaut. It is to have a motor of 100 horse-power.

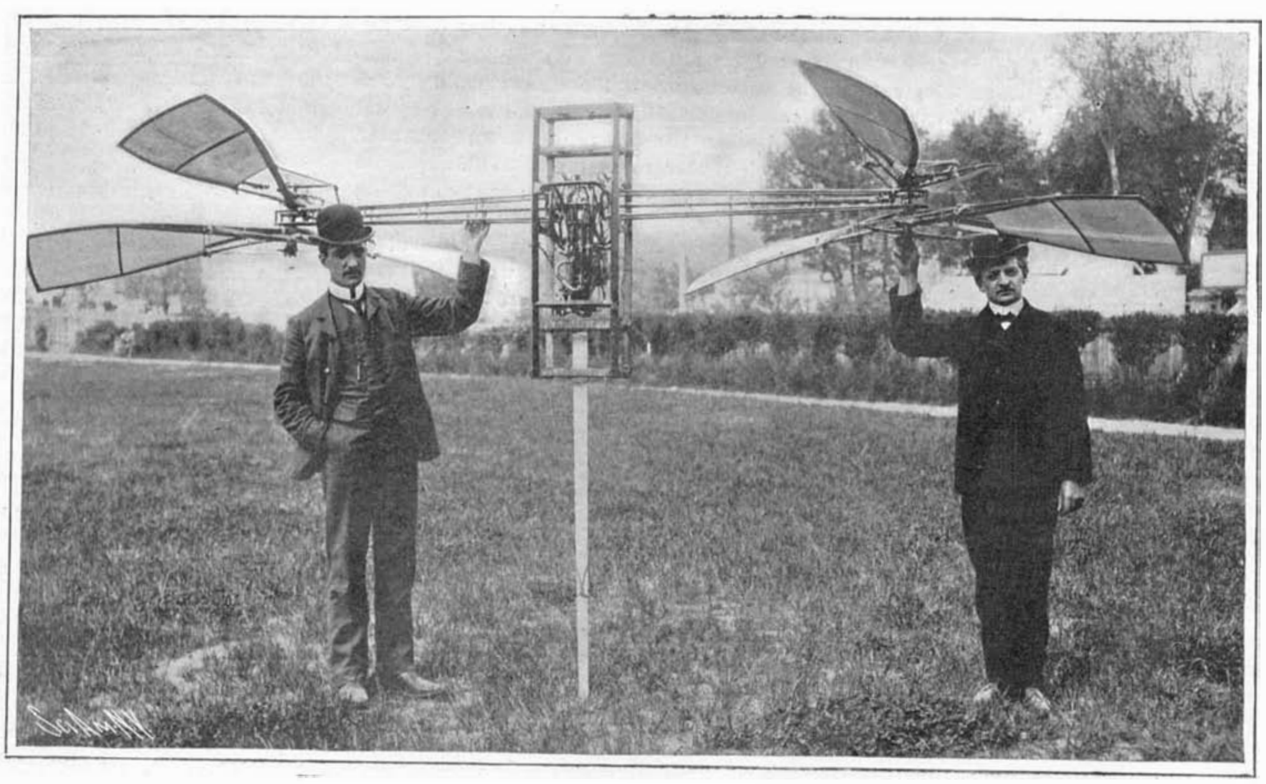


Arrangement of Planes and Driving Mechanism of the Dufaux Flying Machine.

The aviation committee of the Aero Club consider that the Dufaux machine is a great step in advance in the question of flying machines of the aeroplane type. This is owing to the excellent performance of the apparatus and its good balance in the air, a point which is very difficult to obtain with a motor-driven flier, and one in which very few inventors have been able to accomplish anything up to the present. The second point is the question of lightness of the machine compared with the motive power, or how much weight it can lift outside of the dead weight of the apparatus. This is an essential point in the matter of aviators, and one which it is not easy to solve. It is considered that the present experiments go a great way toward a solution of this problem for motor-driven aeroplanes, seeing that we now have an apparatus of great lifting power compared with its weight, and no doubt Messrs. Dufaux will soon succeed in building an apparatus which will lift an aeronaut by means of its propellers.

Effect of Cold on Cellular Life.

In a paper recently presented to the Académie des Sciences, M. Paul Becquerel describes some experiments relating to the action of extreme cold upon cell-life. It has been maintained by different scientists that grain or seeds when cooled down as low as —40 to —250 deg. C. by liquid gases have their vital phenomena entirely suspended. The living matter can be thus preserved as long as it remains at these low temperatures and keeps its vital property, being again restored as soon as it comes back to the normal state. Such an opinion seems to be in contradiction with the ideas which biologists hold as to the continuation of vital phenomena. Accordingly, M. Becquerel was led to make the following experiments in order to throw some light upon the question. The seeds or grain were divided into four series. The first series includes natural dried grain, such as wheat, corn, peas, beans, etc. In the second lot the grains are naturally dried, but are decorticated, including rice, corn, peas, gourd seed, etc. The third lot is dried *in vacuo* over caustic baryta until no more water is given off, while the samples of the fourth lot were swelled up in water for 12 hours. All the specimens were cooled in liquid air for 130 hours, then they were taken out and one part was planted in earth, while the second part was reserved for examination. After a few days, M. Becquerel made the following observation: As to the first lot, some of them grew as usual, while others did not succeed as well. The grains which contained a great deal of water had all been frozen. Of the second lot, which had been decorticated, only three succeeded in growing. All the dried grains of the third lot were found to grow, while the process of swelling in water seemed to be fatal, and the grains were killed. He examined some of the grains which had been killed and finds that this is due either to sudden variations of gas pressure in the tissues or else to the freezing of the contents of the cells. Some of the grains show cracks, which indicates a gas pressure. This is noticed in the case of the gourd and the castor bean. But he also observed the freezing of the cells and found all the phenomena which indicate a gas by Matruchot and Mollard. He concludes that the resistance of the grain to the action of cold depends on the amount of water and gases which it contains. The cold may disorganize the



THE DUFAUX BROTHERS AND THEIR NOVEL FLYING MACHINE.

This view shows the motor and the four two-bladed propellers. The aeroplanes were added subsequently.

protoplasm and make all return to life impossible, but if the protoplasm has already reached its maximum concentration by drying, and consequently its minimum of action, it escapes the action of the cold and does not freeze, thus retaining the germinating principle. The above experiments seem to show, at least as far as they have gone, that the argument in favor of a suspension of life in the grain will not hold.

INTERESTING REPAIR WORK ON A GERMAN STEAMSHIP.

BY DR. ALFRED GRADENWITZ.

A highly interesting repair work on the aluminothermic process was recently carried out at the Bremerhaven imperial docks. The steamship "Friedrich der Grosse," of the North German Lloyd, the sternpost of which had to be repaired, had lost one of her propeller blades on sailing home from Australia to Bremen. As a consequence of the resulting inequality in the working of the propeller, the Siemens-Martin steel propeller shaft bracket had been broken.

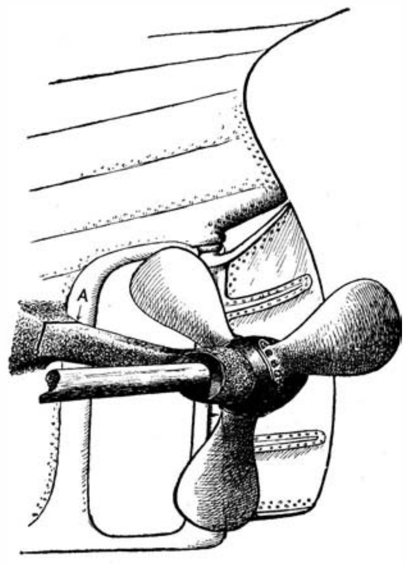
The position of the fracture will be seen from the diagram. In order to obtain access to this point during the welding operation, the plating of the hull had first to be removed to the necessary extent, after which the fracture was widened by 30 mm. (0.12 in.) to make room for the intermediary thermite iron casting. In order to avoid any displacement of the propeller shaft bracket during the operation, it was maintained in the proper position by heavy steel struts and chains.

The mold used is seen in one of the views. As horizontal displacements of the molding box had to be provided for, it was placed on a small sliding way. In order to avoid any leakage of the thermite iron, due to a defective tightness of the mold, the latter was surrounded by an external casing, the intermediary space being tamped in strongly with sand. Besides the admission funnel and the ascension funnel, the mold was provided with a third opening, through which any ashes penetrating into the mold could be blown out. This opening had obviously to be closed entirely before the casting was commenced. A dry sand core was introduced to this effect, the aperture in the walls of the molding box being fitted with a blind flange.

During this preparatory operation, a preheating furnace of sufficient size was erected, and an electrically-driven fan (a so-called sirocco blast) was placed in position. The fire gases for preheating the fracture were allowed to enter through the ascension funnel and to issue through the admission funnel and the aperture just referred to.

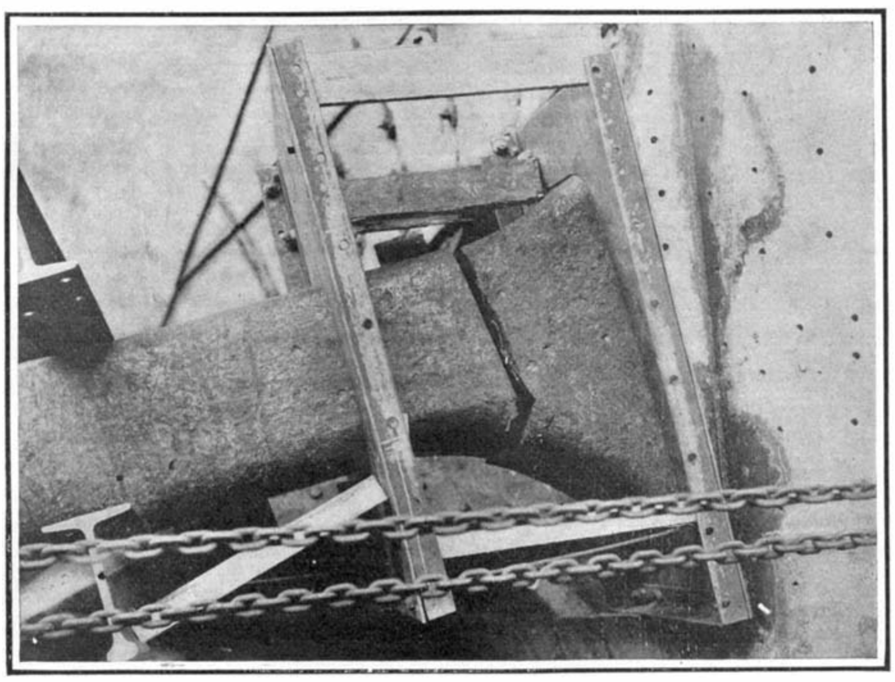
The crucible was surrounded by another sheet-metal jacket, the intermediary space between this and the crucible being filled in with moist sand, thus avoiding the risk of the mold being burned through or the thermite iron escaping. After four hours' preheating the furnace was removed and the crucible placed in position, being held in a ring attached to the ship. A casing, lined with chamotte, was provided, to receive any escaping slags, and the crucible was filled with 350 kilogrammes of thermite, 75 kilogrammes of small shot, and 3½ kilogrammes of powdered manganese, and the mixture was ignited.

The ensuing reaction was quite normal, as expected; and for a full description of this welding process reference is made to articles published in the SUPPLEMENT of January 5, 1901, and September 26, 1903. In this process the mixture of metallic oxide and pulverized aluminium in the crucible was ignited, and the temperature of reaction of about 3,000 degrees reduced the oxide and gave a pure metal, which welded the fracture. About 50 kilos (110 lbs.) thermite was filled in gradually after the casting into the ascension funnel. On the next morning the mold was struck off, when the surrounding thermite iron casting was found to be free from any defects, while the ascension funnel struck off the mold showed a fracture surface of perfect density.

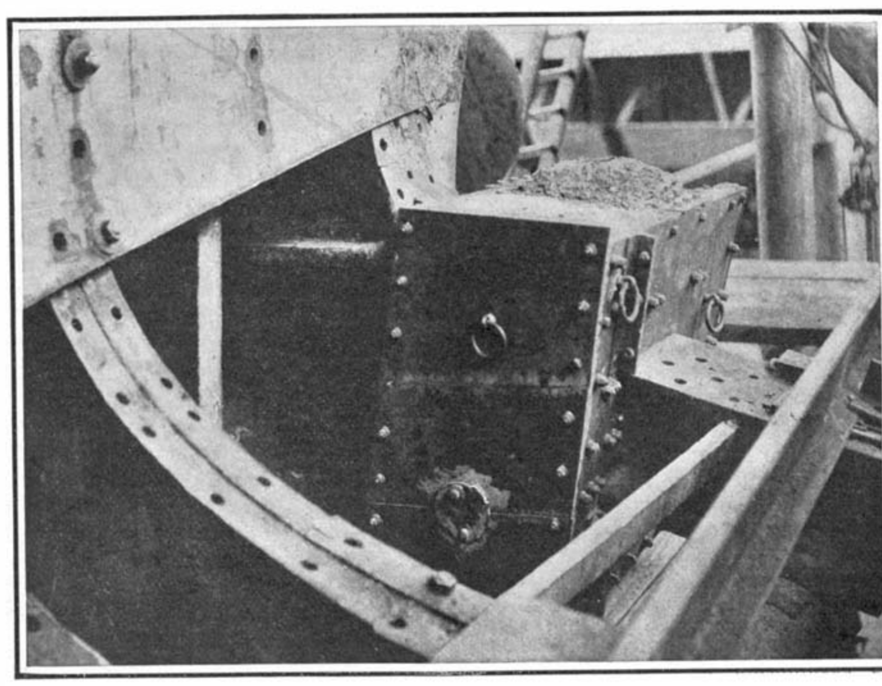


Where the Break Occurred.

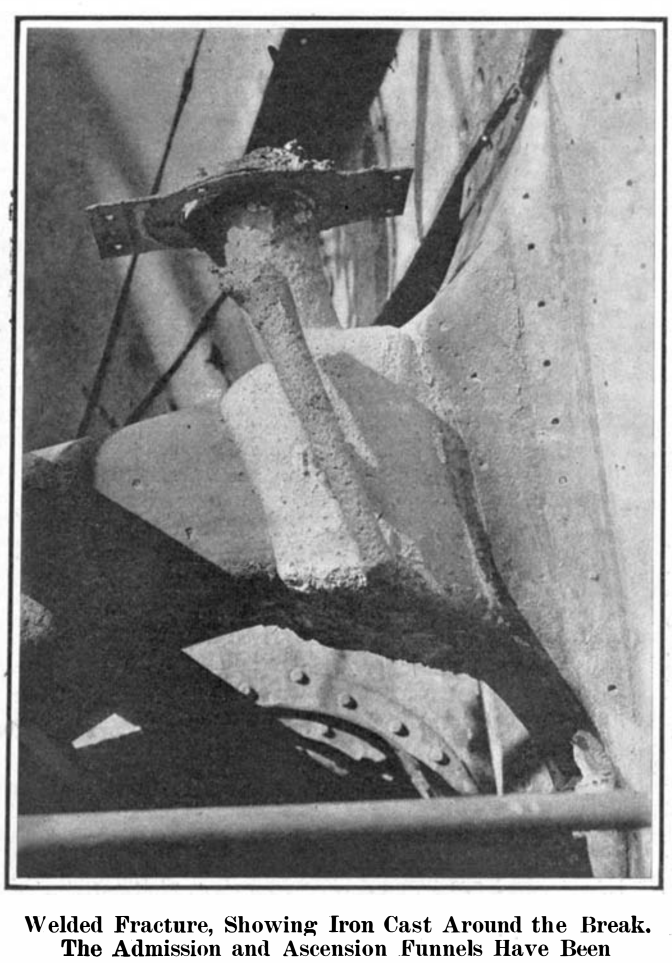
By using the thermite process in connection with this repair work, the North German Lloyd was enabled to place the ship in commission again after a relatively short time, whereas an interval of some months would have been required to prepare a new propeller bracket and to fit it ready for operation.



Sternpost of the "Friedrich der Grosse" Before Welding. The Fracture Has Been Widened 1.18 Inches. The Molding Box is Half Completed.



The Mold Attached to the Fractured Post.



Welded Fracture, Showing Iron Cast Around the Break. The Admission and Ascension Funnels Have Been Left in Position.

INTERESTING REPAIR WORK ON A GERMAN STEAMSHIP.

Care of Hair and Scalp.

One of the most sensible articles on what the "tonsorial artist" calls the "hirsute adornment" of man has appeared in the American Physician and is from the pen of Dr. George W. Spencer. The doctor says:

"With our environments the question of cleaning the hair and scalp is one of great importance.

"Women have an excellent method of washing the hair; this is made necessary by the fact that its length and thickness do not permit of a rough and unsystematic rubbing and scrubbing.

"On the other hand, boys and men think they have to have their scalps and hair scrubbed with soap and water and then dried by violently rubbing with a rough towel, or submitted to a most wonderfully beneficial preparation, called a shampoo, which leaves the scalp in a tender and congested condition favorable for infection and sensitive atmospheric changes.

"The cleaning of the scalp should be very carefully and tenderly performed, using warm water with a mild soap, rubbing in gently and with the ends of the fingers, then rinsing with tepid water and drying by gently pressing the hair and scalp with a very dry towel, continuing until thoroughly dry; or, still better, dry it by fanning. If any application is necessary to bring hair thus dried into shape, dampen with a bichloride of mercury solution 1-2,000.

"Ordinarily this thorough cleaning need not be done oftener than once a week and in the interim the hair needs only to be brushed with a soft brush without allowing the brush to scratch the scalp.

"The stiff brush, and especially that most injurious of all brushes, the military brush, which is frequently used for months several times daily until it becomes filled with dirt, can only be of great injury to the scalp, because of the vigorous scratching, as well as breaking the hair. All brushes should be destroyed and only blunt-toothed combs used to dress the hair, and these should be thoroughly cleaned after each using; and no two persons should ever use the same comb.

"The practice of barbers is a fruitful cause of diseased scalps. They use the same brush for all customers; before combing or brushing the hair, they rub the scalp violently with the ends of the fingers, thus rubbing out other than the hair that, physiologically, is being shed all the time; by this rough usage they injure the scalp and aggravate any pathological condition that may exist, however slight.

"Much injury is done by the use of lotions and dressings for the hair. It would be impossible to mention the many articles used for this purpose. The mixture called 'bay rum' is one of the most common and injurious of those used. Oils of different kinds, highly perfumed (to cover their nastiness) were at one time extensively used, but are now, fortunately, falling into disuse. Normal hair has all the oil needed; the addition of some doubtful article will result in decomposition and consequently be poisonous. Even when the scalp is affected with that most common and little noticed disease, dandruff, the above instructions apply to the care of the scalp. The only lotion that need be used is pure water, unless some disturbance is indicated by slight itching, then a bichlor-

ide-of-mercury solution, 1-2,000, can be sparingly used.

"The mistake of civilization is having lost sight of the fact that the hair is ample for the immediate covering of the head, so it has instituted the custom of wearing hats or caps.

"The English tourist's hat is an ideal hat both for winter and summer.

"When possible no hat should be worn. The opportunities for leaving the hat off are many more than one would think.

"The leaders of fashion could do much toward bringing to pass the leaving off of the hat. The only specific advice that can be given, is to take off your hat whenever possible."

Correspondence.

The Teaching of Science in Schools.

To the Editor of the Scientific American:

The study of elementary science, or "nature study" as it is often called, is a branch of steadily-gaining popularity in the modern school. In many curricula it absorbs perhaps a third of the pupil's time, and probably much more than half his interest. Classes in elementary ologies of all kinds are supplanting the classics and more formal studies of the past. Whether this is an advantage or not is a question I shall not discuss; but no one will deny that it is of the utmost importance that these new studies, if they are to be of any real value, if they are to produce mental fiber of any strength, must be taught thoroughly and well. Grave doubts of such thoroughness inevitably assail many a college examiner after he has waded through the dreary morasses of mental confusion found in numerous entrance papers.

Last June the writer set an examination in physics based upon a well-known college textbook with questions of a fundamental character, and no more difficult than those asked of freshmen who have completed the first year's college course. The result was most discouraging. Many of the candidates did not attempt to answer but one or two of the ten questions required. Those who were more courageous floundered hopelessly through part of the examination, but showed a confusion of mind that spoke ill for the methods of teaching used in the schools they came from.

Before quoting from the papers of these candidates, it will be well to explain that physics is not one of the entrance requirements at Trinity, but like certain other subjects it may be offered to make up the requisite number of courses for admission. The candidate who passess it is then eligible to the second year's college course. In fact, he would not be allowed to take the first course, and count that toward his degree, on the assumption that he has already covered that ground once by his entrance examination. It is thus essential that the questions asked shall be similar to those put to students who have completed Physics I.

The first question was one on fundamental units, and here are some of the replies, taken not from the worst papers, but from an average selection:

"Angular velocity is the distance an object travels when it is thrown up in the air or on its downward course."

"Angular velocity is the distance a body covers in centimeters when moving in another direction to that which gravity would tend to make it go." (This was on the best paper handed in.)

"Acceleration is the speed with which an object travels."

"The unit of the C. G. S. system is the dyne, of linear velocity is the foot, of acceleration is the foot per second, of force is the foot-pound, work is the horse-power, of potential and kinetic energy is the foot per second."

"Energy is the power which *every* body has for doing work." (The universality of this dictum is delicious.)

"The momentum of a body is the rate of speed of that body per second over a certain space."

"The C. G. S. is the unit of force."

Two problems in mechanics were asked, one on a ball projected at an angle of 30 deg. to the horizontal, involving of course a very simple trigonometric solution. This naturally was beyond the ken of those who had not yet learned the meaning of sine and cosine. Another involved the calculation of the moment of inertia of two weights at the extremities of a revolving weightless bar. Neither problem was solved correctly by any one.

The theory of the simple pendulum was left untouched by most. Those who attempted it described how a pendulum swings, and said a little about kinetic and potential energy as exemplified by that useful illustration. Archimedes's principle was variously described. One attempt follows: "Archimedes's principle was based upon the fact that if a solid was placed in water, which exactly filled a receptacle, the water which overflowed would exactly equal the weight of the solid. This made it possible to weigh an elephant, for the water could be collected and weighed a little at a time."

Another is of the opinion that on account of the "impenetrability of matter, . . . when a substance is placed in water it must displace its own weight of water." This view of equal masses was quite popular; about half the papers made a similar assertion.

Such questions as the frequency of the note G♯ when $C = 256$, or the proof of the electrostatic formula

$$\text{Potential} = \frac{Q}{K d}$$

were quite beyond the scope of all but one or two, who made feeble attempts to answer them. But one would look for more information when such concrete subjects as the Wheatstone's bridge were called for, for there is at least some form of wire bridge in any school laboratory; so it was a genuine surprise to have a boy who came from an excellent preparatory school say: "Wheatstone's bridge consists of two bars (hor.) some inches from each other. Across them a string is strung, one end hanging over having a weight attached" (diagram here), etc. (Of course an attempt to describe some method for finding the modulus of elasticity of a wire.) Other attempts at the famous bridge gave incorrect diagrams, usually a faulty picture of the piece of apparatus used in the school laboratory; and even the fundamental proportion was often incorrectly stated.

Questions on the electrical and magnetic units produced some amazing information.

"Susceptibility is the power of showing the slightest current."

"Magnetizing force is the power which does the magnetizing measured in volts and amperes."

"The magnetizing force is the force required to magnetize a body."

"Magnetic induction is the magnetism excited inside a helix, although no electrical connection has been formed." One sees in this last reply what ideas were groping in the poor confused brain, but the wonder is how the clear-cut mental focus of a future bank president or manufacturer can evolve from such vagueness and inability of expression.

Apparently no one had ever heard of the diffraction grating, and the spectra of incandescent solids and gases are both hazily described as having "lines," by the few who ventured into the realm of optics at all.

These samples taken almost at random give an idea of the sort of paper that was handed in. Of course, some questions were answered correctly, but the impression left in the examiner's mind was one of having come in contact with an intellectual fog, and his belief in school science has been (perhaps unfairly) correspondingly shaken.

As physics is the author's department, this discussion must necessarily take its departure from that subject, and I am convinced that work in what might be called the more descriptive sciences, such as botany or geology, or even chemistry, is of a more satisfactory nature. Physics, next to mathematics, is the most exact science in the sense that there are known to physics more fundamental laws capable of exact mathematical expression than to any other science. Even astronomy does not precede it, for the exact position of astronomy is a branch of mechanics, and the science of astronomy is still in its infancy. In teaching such a subject, then, one cannot lay too much stress on the underlying principle, the law behind the experiment, that the experiment is only intended to illustrate. When a certain phenomenon follows by an unassailable chain of deductions from a certain great principle, the experimental demonstration of this phenomenon fails entirely in its purpose if the connecting logical links are not understood. And it is this lack of the logical or mathematical background to the experimental course that seems to me most apparent in the papers just discussed. The boy has carefully plotted the field about a magnet with the aid of a compass, but to him it is only the particular case of a compass and a magnet, and underlying notions of magnetic induction, tubes of force, law of inverse squares, etc., have nothing to do with the diverting little task in hand. The teacher perhaps has a class of thirty or more working together in the laboratory, and he is able to do little more than see to it that the experiment is done correctly, a neat report handed in, and certain explanatory references given to the pupil, who goes out with a recollection of only a certain particular example of a great law. If that law is presented to him in a slightly different form, he is utterly at sea, and flounders about for some support from among the concrete experiments that lie scattered about in his mind, unconnected and far apart.

This clinging to the concrete belongs to extreme youth, so the sciences that deal largely with the classification of concrete cases are better taught in our schools, and are usually more palatable to the pupils. But by the time a boy is seventeen or eighteen years old, it is a mistake to let him cling too closely to the concrete. When he thinks of numerical relations, he no longer has to cut imaginary apples into fractions, or distribute oranges in certain ratios among little boys. Why, then, is he not able to grapple with the abstract generalizations of science? I do not mean that he should abandon the laboratory exemplification of the laws he is learning, but the principle should be made the central idea which experiment is only to prove and illustrate. Of course, historically speaking, experiment preceded principle, at least in most cases, but the inductive method in teaching is far too apt to confuse the pupil, who seldom has the maturity of mind necessary for unaided generalization. Moreover, it is the glory of modern science that new phenomena can be predicted from known laws, and the deductive side is to-day as essential to progress as the inductive.

The cause of this unsatisfactory condition, at least in the teaching of physics, lies largely in the textbooks used in schools. Why must the boy taking physics in his last year at school study from the childish book often used, when if he begins the science a year later in college he studies from such authors as Watson, or Hastings and Beach, or Carhart (to mention only a few admirable college textbooks)? Surely, a year cannot make so much difference in his mental equipment! It will be urged that the books named above involve an understanding of trigonometry. True, but the amount of trigonometry needed by the student of Watson, for instance, could be readily mastered in three or four lessons, so this is no serious barrier to the teacher who really wishes to use a "college textbook." In many elementary courses no textbook is used, and the lecture system is followed. This may give satisfactory results in some subjects, but in physics it cannot be too severely condemned. In order to train the student to think, he must be compelled to work for himself; and though the lecturer may give references and advise study, those who have tried it know how hard it is to exact the outside work so necessary in a mathematical science like physics: and the ability to wrestle with a difficult problem or concept is not fostered by what may be termed the "kindergarten method" in science.

Too little time in the classroom, or, what amounts to the same thing, a disproportionate stress on the laboratory end, is also in part the cause of the evils we are discussing. This would not be so if classes were small, and the instructor could devote himself individually to his pupils, thus making the laboratory a more efficient lecture-room; but generally the classes are too large, and the pupil depends upon printed directions, and an inexperienced assistant instructor, so the two or three hours spent in the laboratory are not the equivalent of a well-conducted recitation involving a preparation of an hour or more of hard study.

Among the causes of inefficiency in teaching school science, that which one would least anticipate is the extraordinary opinion which seems to prevail among school boards and principals that any youth who has had a year or two in a science at college is capable of teaching the subject. This careless attitude toward a field rapidly overtopping many more time-honored subjects of school instruction, is almost inexplicable. Why should a teacher of Latin be chosen with so much more care than the teacher of physics and chemistry? With the increasing reaction in favor of science, this is the more surprising. If science is to supplant the classics in popular esteem as a fitting for an active useful life and the development of a well-trained mind, then let the teacher be one of sound knowledge as well as high intellectual ideals, and not merely a genial spirit who can play football with the boys in recess and bluff successfully when cornered by an inquisitive pupil in the classroom. I have seen appointments made by excellent schools that for unfitness on the part of the appointee rival the political appointments of a Tammany administration unchecked by even a pretense of civil service restraint.

The main reasons for teaching science in school are to awaken the pupil's interest in nature, give him some information about its chief laws and phenomena, and to train his mind to think clearly and with concentration. It certainly is open to question whether either of these aims is realized in many otherwise excellent schools. The interest possibly is stimulated in a general sort of way, but the misinformation that seems to remain as an ultimate residuum is worse than valueless, and the power of clear, concentrated reasoning has apparently not been fostered to any very high degree.

If science cannot be taught well, it is far better to let it alone in preparatory courses. The final result will be more satisfactory, even to a boy who means to study engineering in college. The truth of this assertion was well illustrated in the writer's experience by the case of a pupil who, though far from dull or lazy, was almost the poorest in his class. On being questioned, he replied that he had had physics in school, and when he came to study his lesson it seemed familiar, and he was tempted to trust to his recollection of what he had learned in school, although his recitations always showed that knowledge to be valueless. If he had never had the subject before, he would have been forced to work and might have learned something. The school that has a long list of science

courses on its catalogue's pages is falling in with a popular fad. I do not say the fad is wrong, but like all fads it is capable of abuse, and unless each of the courses is conducted at least as well as the course in Xenophon or geometry, requiring as much real work by the pupil and with the same definite results, the course is worse than a sham. Let the school authorities face the fact that in science, as in all other activities, good results can only be produced by skilled workers, and the skilled workman is more expensive than the untrained novice. Either the best or not at all should be the policy of every school that contemplates adding a course in science to its list of studies, if that course is to be anything but a bait for the children of unsophisticated parents, and a diversion more or less demoralizing to the pupil.

Henry A. Perkins,
Professor of Physics, Trinity College.
Hartford, Conn., October 2, 1905.

A Chance for Inventors.

To the Editor of the Scientific American:

As at present the price of heniquen is declining in the American market, the imperious necessity makes itself felt of increasing the acreage devoted to the production of this fiber and of realizing savings in its management from the planting to the baling. With the extension of the plantations which is already in actual progress at present, although not to the extent to which it should be carried, there will be secured a material increase in the quantity of fiber produced, and this increase in production will make up in part for the loss that follows the decline in price which began some time ago and which decline in price can be entirely overcome by the economies or superior methods of exploitation which may be introduced into the industry. It is evidently most pressing that these economies be undertaken at once, and this is possible in two directions: First, that of utilizing, in some manner, the refuse which results from the threshing or breaking of the textile, and second, some mechanical method of drying the fiber. In both these directions there is now a real waste of time, of labor, and of money. In respect to the former, there is a great waste in carrying to the place for threshing a great quantity and a great weight of leaves of heniquen, which, reduced in small part, by the operation, must then be transported again, with still greater labor, to the place chosen for deposit to rot. But this is not the only drawback. This place is at once converted into a fearful source of infection which poisons the atmosphere and the water which the plantation must use, and from which contamination is developed disease in various forms to such an extent that plantations that were noted previously for their salubrity have become converted into homes of disease.

Moreover, feeding this refuse to cattle, which is done generally when it is in a rotting condition, makes the milk poisonous and develops also in the calves and young stock different diseases, one of the most common of which is dysentery, as experience teaches us, thus demonstrating the error of the popular belief that this refuse can be used as a good food for cattle.

In order to overcome these obstacles and to diminish as much as possible the cost of production of heniquen, it has occurred to us that, by means of a mechanism invented for the purpose, this refuse might be utilized as a combustible, or for some similar purpose, obviating a waste and producing instead an actual profit to the planter.

The spreading of the fiber in order to dry it in the sun is an operation quite primitive, and which is certainly behind the time, in view of the scientific progress of the age. To do this work requires a considerable force of laborers who must carry the fiber to the place selected for drying, there spread it, then turn it and gather it in, as it may appear to be dried, and finally transport it to the press. This operation, besides being costly, has several drawbacks that make it objectionable. Among these drawbacks it appears to us that the chief are: the loss of fiber that results from spreading and transporting it, as a considerable quantity must necessarily be lost either on the wires, on the grass of the route back and forth, and even on the very ground of the drying place; the deterioration of the fiber by the fall of sudden rains, and finally the loss of time which results in the rainy season, because as the rains are constant during sometimes many days in succession, the planter finds himself obliged to suspend the cutting and the separation of the fiber of the heniquen by reason of having his drying space already overflowing with fiber.

The strong winds which prevail during the fall are equally prejudicial, as the fiber is thus blown from the wires and scattered, some of it carried even beyond the limits of the place for drying.

In order to overcome these inconveniences and others that we have not mentioned because of the necessity of keeping our article within reasonable limits, there might be invented a mechanical dryer, into which the bundles of fiber might be thrown when delivered from the threshing machine, and be delivered by the new mechanism dry and ready for baling.

The points which we have referred to so briefly are so important for the state in general that, in our opinion, they are very well deserving of the special attention of the Heniquen Planters' Union, which should adopt means suitable to attain the object which we have indicated. This union might, without any delay, call a special meeting in order to consider this very important subject. A petition might be formulated to be sent to the governor, who is so firm a friend of progress in our state, requesting that he recommend to the legislature that a prize be provided, to be bestowed upon the inventor of any successful machine contrived for the purpose as explained above. This Heniquen Producers' Union might also do something which, in our opinion, would be the best possible thing to be done, and that is to try to raise by voluntary subscription among the heniquen planters a sum sufficient to provide the prizes referred to for donation to the inventors of the machinery in question, which fund should be used solely for the purpose of rewarding successful attempts to provide such machinery. If this course should be taken or adopted by the union, the writer of this article holds himself ready to provide five hundred dollars toward each prize.

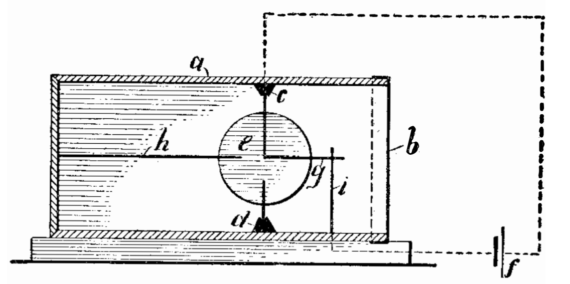
Vicente Solis.
Merida, Yucatan, Mexico.

A NOVEL PROCESS FOR DISENGAGING FORCES BY MEANS OF SOUND.

BY OUR BERLIN CORRESPONDENT.

It is a well-known fact that bodies capable of emitting sounds (membranes, cords, etc.) are caused to vibrate intensely by any outside body placed in their neighborhood and sounding the same note, while a vibration of less intensity is observed in the case of sounds of different pitch. A striking phenomenon based on the fundamental notes of resonators is described by Mr. H. Michel in a recent issue of Prometheus.

If a light disk be arranged within a resonator or sounding-box so that it can be readily rotated upon its axis and the fundamental note of the resonator be given off by any acoustical source in the neighborhood, the disk will be set rotating and will continue to do



A NOVEL PROCESS FOR DISENGAGING FORCES BY MEANS OF SOUND.

so until the sound is discontinued, provided it be adjusted at an oblique angle to the longitudinal axis of the resonator. No effect is observed if the sound be different from the fundamental note of the resonator. Mr. Michel suggests using this effect for disengaging forces by means of sounds of a given pitch. The rotation of the disk can, for instance, be utilized to throw in or out, weaken or reinforce electric currents that might be used to start any special motor.

An arrangement suitable for this purpose is illustrated in the accompanying engraving. *a* is the longitudinal section of a resonator, closed by the membrane, *b*. A light disk, *e*, carrying a lever, *g*, connected with the cell, *f*, is pivoted in the cups, *c*, *d*. The rotation of this disk is limited by the prongs of a fork, *h*, fixed to the bottom of the resonator. An extremely feeble tension due to a weak spring, a magnet, or the like, presses the disk against one of the prongs of this fork, so that the disk is adjusted in a position of rest at an oblique angle to the longitudinal axis of the resonator.

If, now, any instrument, e. g., a piano, be played in the neighborhood of the resonator, the disk will remain at rest until the fundamental note of the resonator is given off. At that very moment it will start to rotate, trying to adjust its surface at right angles to the longitudinal axis of the resonator, and will throw the lever, *g*, against the metal bar, *i*, which is connected to the other terminal of the cell, *f*, thus closing the circuit. As the contact between the lever, *g*, and the bar, *i*, is maintained as long as the sound is continued, the current, being completed throughout this time, will be able to perform some given operation. The effect of the fundamental note of the resonator on the disk is reinforced considerably by means of an acoustic funnel arranged in front of the membrane. In this case the rotation of the disk begins nearly instantaneously and rather energetically, as soon as the note is struck. This novel process would seem to be capable of many practical applications.

A vine now standing in California, which is considered the largest in the world, was planted in 1842 by a Spanish woman. Beneath its spreading branches, which cover nearly half an acre, 800 persons could find protection from the sun's heat. The first election in Santa Barbara County under American rule was held beneath its ripening fruit. The vine is of the Mission variety. In 1893 it bore 8 tons of grapes, and in 1895 over 10 tons. The trunk of the vine is 7 feet 8 inches in circumference. It is now owned by Jacob Wilson, of Carpinteria, Cal.

Electrical Notes.

A novel wireless telephone apparatus has been patented by M. Blondlot, of Paris. The transmitting antenna is excited by the effect of a closed circuit where continuous vibrations of very high frequency are produced by the stepwise discharge of a direct current or alternate current generator connected in parallel to a condenser battery, while the receiving antenna acts on a telephone with or without the use of syntonically vibrating local currents and wave detectors. The sounds to be transmitted act on the closed vibratory circuit by means of a manometric flame or a transformer, the primary coil of which is fed by a strong microphone, a singing arc, or any similar device.

A special wireless telegraph corps has been established for some time past in the German army, where the previous wireless telegraph battalion originally connected with the aeronautical battalion has been attached to the telegraph corps as an independent body, though it be intimately related to aeronautics in so far as captive balloons are required to suspend the sending antennæ. The importance of wireless telegraphy for the signaling service has been illustrated in the Russo-Japanese war and is being evidenced also in connection with the military operations carried out by German troops in Southwest Africa. Wireless telegraphy, while ready to work at a moment's notice, is less liable to be observed or interfered with by the enemy than any other means of communication, quite apart from its other advantages. It may be said messages have been sent for 250 miles in South Africa.

The utilization of electric energy for power purposes in the spinning mills of the Marquess of Larios at La Aurora and La Industria mills at Malaga, in Spain, recently installed, has been attended with some remarkable results. At La Aurora mills, the substitution of steam engines driving gear and belting, by electric motors driving direct on to the line shafts, has reduced the power consumption by 40 per cent. Furthermore, the steadier drive obtained from the motors has increased the yarn production by 20 per cent, owing to the avoidance of yarn breakages. The mills at Malaga are equipped with 72 motors aggregating 2,350 horse-power for ~~three~~-phase current, and range in power from 15 to 150 horse-power. The average efficiency is 91.1 per cent, and the average power factor 88.1 per cent. The electrical energy is transmitted a distance of some 20 miles at a pressure of 25,000 volts.

Experiments on a new type of telephone cable are said to have been made in Sweden with extremely favorable results. In manufacturing these cables, the intention had been to reduce their capacity to a minimum by passing the bare copper wires through perforated disks of insulating material and introducing the cable thus formed into an iron tube. The distance of the two conductors of the same line is 17 millimeters, that of two lines 28 millimeters, and the distance of the conductor and iron sheath in the most unfavorable case 5 millimeters. By this arrangement the capacity of the internal conductors of 2 millimeters diameter was reduced to 0.00985 microfarad for 1 kilometer and that of the outer conductors to 0.0182 microfarad per kilometer. The copper wires are of course wound helicoidally to avoid induction effects. If the above distances be increased to 20, 36.5, and 10 millimeters respectively, the capacity will be 0.00935 and 0.0125 microfarad. Excellent results have been obtained in connection with the experiments made on these cables, especially those relating to the insulating resistances.

The Current Supplement.

The maple sugar industry is thoroughly described and illustrated in the opening article of the current Supplement, No. 1555. A possible source of future fuel is to be found in the vast peat bogs in some sections of the world. How this peat may be commercially utilized, is explained. A full description of Sir Oliver Lodge's fog-dispelling apparatus is given. Mr. Walter P. White describes a new form of cell. Mr. Edward F. Chandler describes in a practical way the construction of a hydrometer. Dr. A. F. Cuzner writes on the origin and control of yellow fever. Exceedingly interesting is a well-illustrated article on jelly fishes. The agricultural application of the gasoline automobile is made the subject of an instructive article by the English correspondent of the Scientific American. Mr. J. H. Morrison, the author of "American Steam Navigation," gives a splendid historical summary of iron and steel hull steam vessels of the United States. Of practical interest is an article on a folding Malay kite. An excellent paper by Prof. Albert Granger on the manufacture of Sèvres ware is presented.

ELECTRIC POWER DEVELOPMENTS AT NIAGARA FALLS.—II.

125,000-HORSE-POWER PLANT OF THE ELECTRICAL DEVELOPMENT COMPANY.

In our first article on the electric power development of Niagara Falls, published in the Scientific American, August 12 of this year, we gave a general survey of the situation, in which it was shown that at the present time there are in operation, or under construction, on both sides of the Niagara River, electrical power plants whose combined horse-power is about 500,000, and that if to this amount be added the total amount of power for which charter rights have been granted, the total development at Niagara, when the full limit of these charters has been reached, will be about 900,000 horse-power.

At present, the principal scene of activity is the stretch of foreshore on the Canadian side, reaching from the commencement of the upper rapids to the huge power station of the Ontario Power Company which extends along the foot of the cliff between the Falls and the new steel arch bridge.

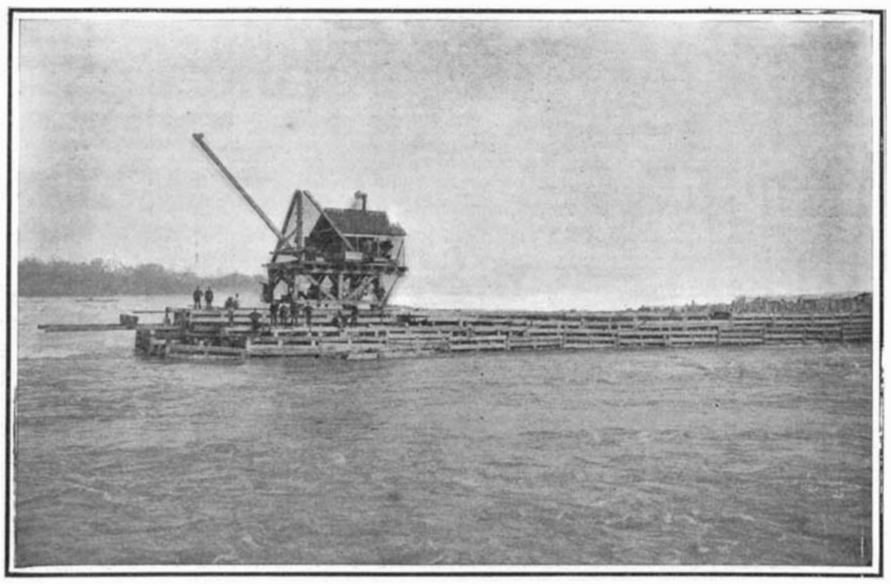
Following down the shore line of the Niagara River for a distance of 1,500 feet from the intake of the Ontario Power Company, whose plant was described in our issue of August 12, we come to the huge plant of the Electrical Development Company, where the work of developing 125,000 horse-power is being pushed to completion with remarkable activity. There are some respects in which this plant is the most original and interesting work of the kind that is being done at Niagara Falls. Briefly stated, it includes, first, a massive concrete gathering dam which extends out from the river bank, and curving upstream thrusts its arm boldly, for a distance of 700 feet, into the deep and swiftly rushing waters of the rapids; second, a vast wheel pit, with hydraulic turbines at the bottom connected to electric generators located in a magnificent power station above at ground level; and, third, a tail-race tunnel which has been carried in a direct line beneath the river, 150 feet below its surface, to discharge the spent waters at the base of the perpendicular wall over which the Horseshoe Falls descend.

Not a little of the expense and difficulty attending this great work was due to the necessity of building out into the rapids a massive cribwork cofferdam, with which to thrust the rushing waters of the rapids aside, and uncover the river bottom preparatory to building thereon the concrete gathering dam. The space to be unwatered was about 12 acres in extent, and the dam, in spite of the fact that it was a merely temporary construction, varied from 20 to 46 feet in width, and had a total depth of water against it, when it had reached out into the deepest part of the rapids, of 26 feet. Its length from the shore to its extreme point is 2,115 feet. For the greater part of this distance the cofferdam is 46 feet in total width, consisting on the outer or river side of a structure 24 feet in width and 32 feet in height, and on its inner side of another structure 16 feet in width, and of about the same height, with a 6-foot space between them filled in with puddle to render the cofferdam water-tight.

The construction of this work in still water would have been a matter of considerable magnitude; but when we bear in mind that it had to be carried out into a mighty cataract which was running 26 feet deep at a velocity of 15 miles per hour, the daring of the work and its inherent difficulties can well be understood. These difficulties were aggravated by the fact that the river bottom was extremely rough and uneven, full of boulders and deep fissures. The dam was built out in 16-foot sections. Each section was constructed in the still water under the lee of the dam, and then launched into place; but before building the section, it was necessary to make a survey of the river bed. This was done from a platform which was suspended out from the completed dam, the contour of the bottom being determined by sounding with iron rods. The new section was then floated out into position in the rushing torrent, and to prevent its being carried away, a sliding shield, built of massive timbers, was moved forward along the outer face of the dam to act as a kind of temporary breakwater. The new section was brought forward into the lee of this shield, drawn into place by steel cables, and loaded down with rock. A glance at the accompanying views of the unwatered bottom of the rapids and of the launching of a new section shows how extraordinarily difficult an undertaking this was.

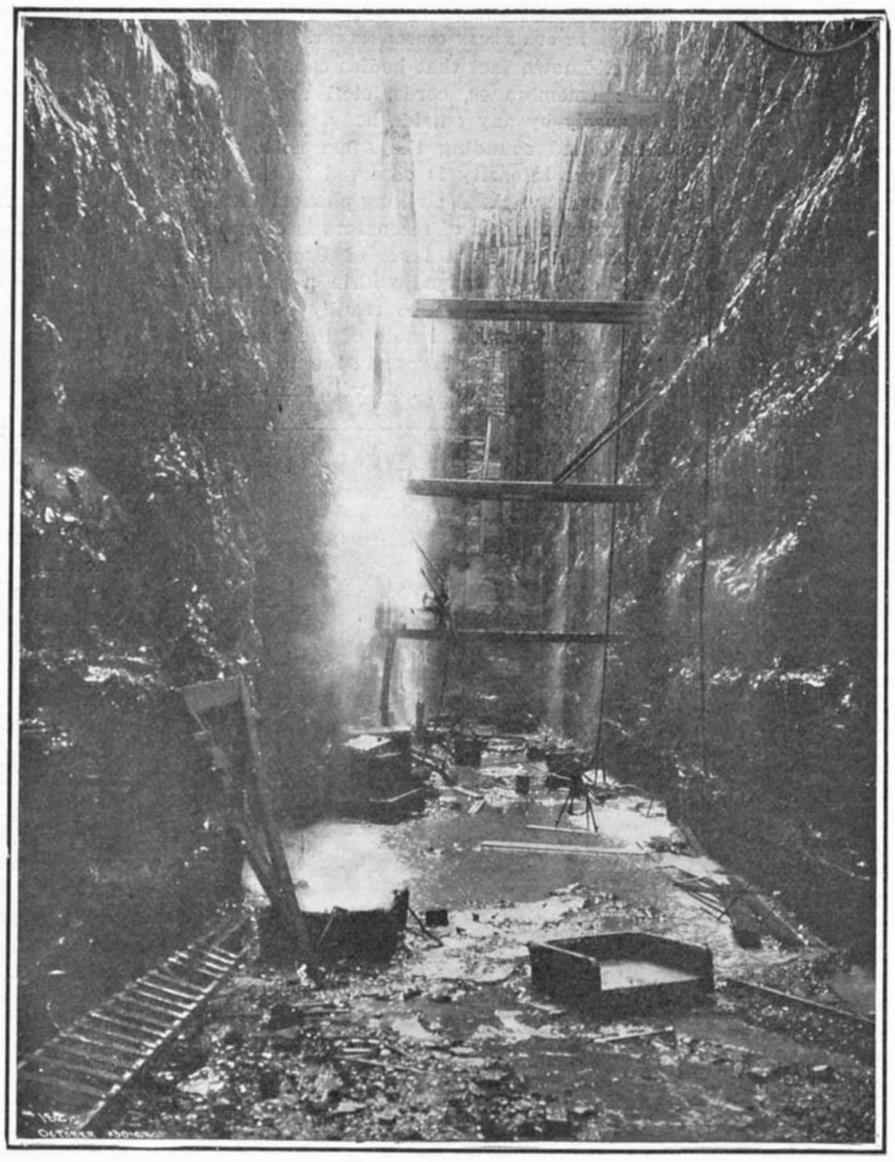
When the cofferdam was completed and the river bottom laid dry, a concrete gathering dam, 33 feet in width and 26 to 33 feet in depth, was built out from the shore, the inshore end being located just below the intake of the wheel pit, and the dam extending out diagonally into the rapids for a distance of 700 feet. The crest of the dam is somewhat lower than the surface of the water, for which it will act as a weir or spillway. The crest of the dam at the inshore end is built at a lower level than the rest of the structure, this being done in order to insure that there shall be a steady and somewhat swift current sweeping past the outer row of submerged arches through which the water will flow into the tubes leading to the wheel pit. The effect of this current will be to carry floating ice and general debris clear of the intakes. It is exceedingly important that the water that enters the penstock, as the large tubes leading down to the turbines are called, should be kept clear of floating debris; for if this should pass through it would not only cause rapid wear and possibly the wrecking of the water turbines, but it would set up serious friction and greatly impair their efficiency. In order to prevent this, the intakes, of which there are two, consist of two parallel walls of heavy concrete carried upon submerged arches. The artificial current created in the forebay by the lowering of the inshore end of the gathering dam, as above described, causes the ice and drifting debris to be swept safely clear of the submerged arches on which the wall is carried. After passing through the two parallel rows of submerged arches, the outer one of which is practically a continuation of the shore line of the river, the water flows through a screen, which effectually catches any of the finer debris. Opening into the inner forebay on the inshore side of the rack are eleven steel penstocks 10½ feet in diameter, which conduct the water to the bottom of the wheel pit.

The Wheel Pit.—The wheel pit is a huge excavation 27 feet in width, 421 feet in length and 138 feet in depth, which has been blasted out of the solid rock in the unprecedented time of eight months. Two branch tailraces each 26 feet in diameter extend parallel with the wheel pit and below the floor level, one on each side, and converge into one huge tail-race tunnel which has been excavated in a straight line, for a distance of 2,000 feet, to the Falls. Founded directly upon the solid rock at the bottom of the wheel pit are eleven massive turbines of the type shown on our front-page engraving. Each of these has a capacity of 13,000 horse-power at three-quarters gate. Although the charter of the company is for 125,000 horse-power, the generators under overload conditions would have a maximum capacity of 165,000 horse-power. They are of the vertical type and the power is transmitted from each one by a massive vertical hollow shaft 115 feet in length, which extends up through the wheel pit, and is supported at three intermediate points by solid masonry bearings. Each shaft carries at the top, in the great



This structure, 46 feet in width, and 2,115 feet long, was built to divert the water from the site on which the gathering dam was built.

The Main Cofferdam.



This excavation is 421 feet long, 27 feet wide, and 138 feet deep.

At the Bottom of the Wheelpit.

This shows the condition of the river bottom on the site of the outer basin.

Bottom of the Niagara Upper Rapids, Unwatered.

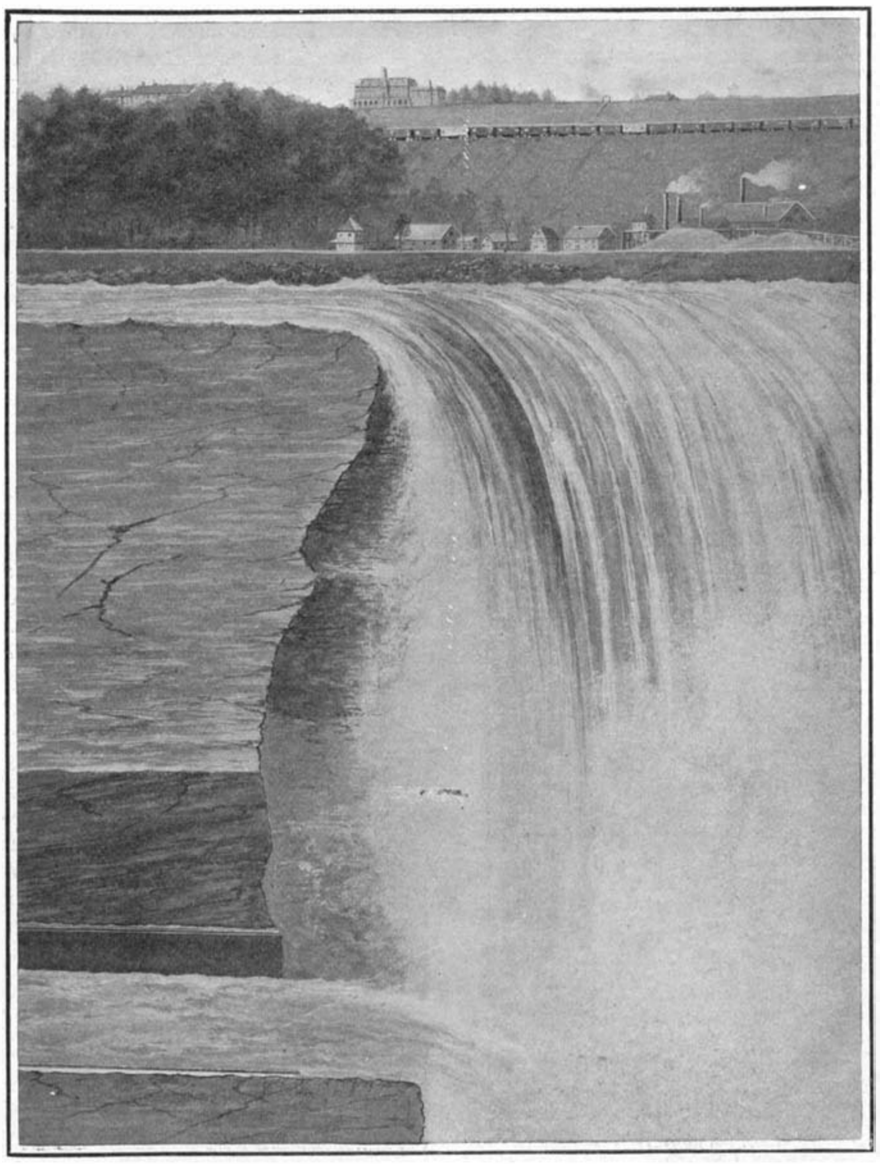
ELECTRIC POWER DEVELOPMENTS AT NIAGARA FALLS.—II.

generating station at ground level, an electric generator of 9,375 kilowatts capacity. The turbines discharge into the two branch tailraces, five of them to one side, and six to the other. This is a new and excellent feature in this plant, for by the use of two separate branch tunnels it becomes possible to close down one-half of the station for repairs while the other half is running. Thus to all intents and purposes the Electrical Development Company has two stations, absolutely independent of each other, at command. A valuable advantage of this arrangement is that frequent examinations can be made of the turbines, shafting, and generators, and any trouble may be detected in its early stages. A further advantage is that the turbines will be at all times accessible, and will not be continually more or less flooded, as they are in other plants.

The Tailrace Tunnel.—The two branches of the tailrace merge at the downstream end of the wheel pit in one large tunnel, which is carried in a straight line and with a fall of 20 feet in its total length of 2,000 feet, through to the cliff over which descend the waters of the Horseshoe Falls. This is the most daring piece of engineering in the whole work, or, indeed, in the whole range of power development as carried out by the various Niagara companies. Had this tunnel been carried around beneath the shore line to discharge, like that of the Canadian Niagara Power Company's plant, through the side of the gorge, the tunnel must have been built on a curve and its length would have been considerably greater. A remarkable feature of its construction is the fact that it was built from the lower end toward the wheel pit. This was done from motives of economy; for to have commenced at the wheel pit end would have necessitated hoisting the excavated material to the surface, through an average height of 135 feet. By building it from the lower end, it was possible to dispose of the material by dumping it out through the face of the cliff, where it was speedily washed away by the rush of the falling waters.

As a preliminary to driving the tunnel proper, a shaft was sunk on shore near the edge of the Falls, and a working tunnel was driven parallel with the Falls to the point of exit of the big tunnel. After the working tunnel had been carried to within a short distance of the line of the main tunnel, the engineers drove a short cross drift out through the face of the cliff, in order to investigate conditions. When the final shot was fired the mass of falling spray and broken water was driven by its own velocity and the pressure of the wind into the working tunnel so fast that the workmen barely escaped with their lives, and the water came in such volume that the pumps were not able to keep it down.

After great labor and danger, the outlet was reached by traveling along the debris at the foot of the cliff behind the Falls, and the obstructing debris was removed by successive blasts of dynamite, thus draining the tunnel. In the whole of this work, which was carried on without interruption until its completion, remarkably quick tunnel excavation was done. In the first drift of the main tunnel, whose section was 13 feet high by 27 feet greatest diameter, the work was carried along at the rate of 50 feet per week, and the main drive, including the yellow-pine timbering, was excavated at a rate as high as 68 feet per week. The diameter of the excavation was 30 feet. The tunnel is lined throughout with 24 inches of concrete, which is worked in between the pine timbers, the latter being left imbedded in the concrete. The finished diameter of the tunnel, when the latter had received its final concrete coat, was 25 feet.



Showing the outlet of the tailrace tunnel for discharging the water behind the falls.

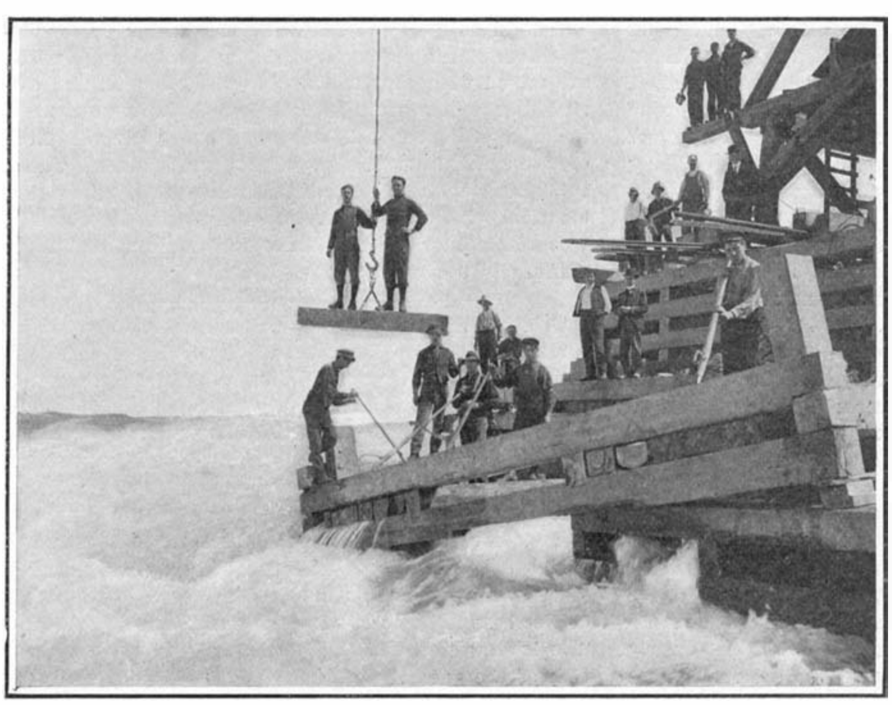
Section Through the Niagara Falls.

The Turbines and Power Station.—The eleven turbines are the largest ever constructed. Time was when we had to go abroad to secure hydraulic machinery of the largest size, and, indeed, the water wheels of the first installation of any magnitude at Niagara Falls were built in Switzerland. Of late years, however, American manufacturers have taken up the design and construction of large turbines so successfully that it is no longer necessary to send abroad to secure them. The turbines under consideration were designed and built at the works of the I. P. Morris Company, of Philadelphia, to whom we are indebted for our illustration. To the right is seen the lower portion of the huge vertical penstock, 10½ feet in diameter, which opens into two annular passageways that lead entirely around the axis of the turbine. They deliver the water to the two water wheels, through which it passes into a central chamber to finally pass out through the draft tube into the tailrace tunnel. The speed of the wheels is regulated by two cylindrical, vertically-sliding gates, one at each wheel, which are operated by an electrically-controlled governor in the generating station above.

The Generating Station.—In the design of the generating station which, in its completed condition, will contain eleven 12,500-horse-power generators, the company have endeavored to put up a building which, architecturally, will be in keeping both with the magnitude and dignity of the plant and with the beauty of Victoria Park, in which it is located. The building, which will be 500 feet long, 70 feet wide, and 40 feet high, will be in the style of the Italian renaissance. The front façade will show a lofty center bay, two end bays, and two loggias, each with an imposing colonnade. The surrounding grounds will be laid out suitably to the general landscape effect of Victoria Park, and it is believed that so far from being an eyesore the building will be a decided addition to the scenic attractions of this justly-famed resort. We are indebted to Mr. Beverly R. Value, chief engineer of the Electrical Development Company, for facilities and information given during the preparation of this article.

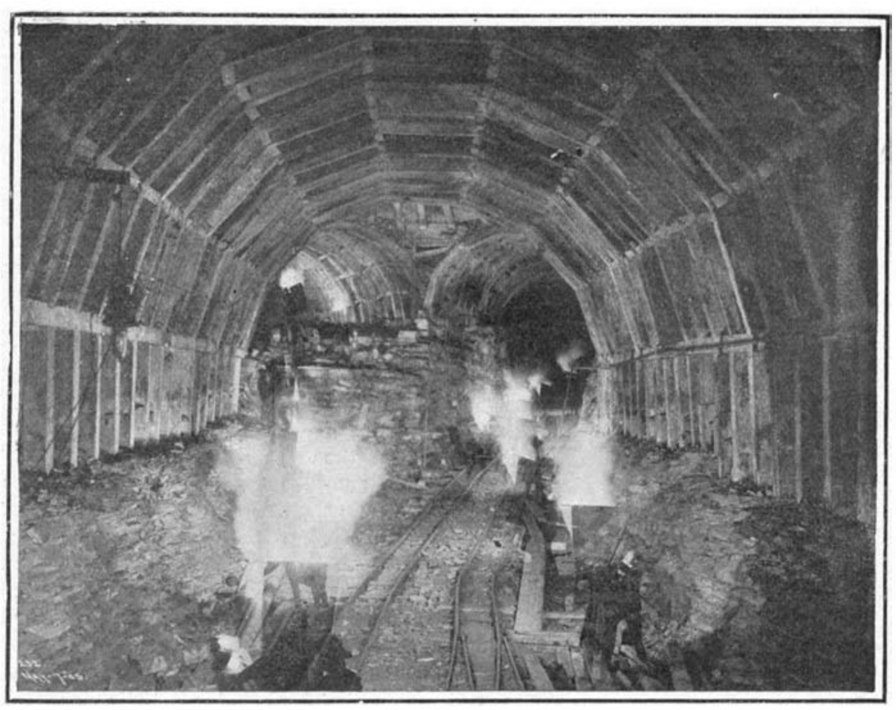
The hydraulic portion of the work was designed by Mr. Hugh L. Cooper and executed under the direction of Mr. Beverly R. Value.

A time-recording camera which will prove of great utility in timing automobile races, where exactitude is such a great requisite, has been devised by two English inventors. The feature of the apparatus is that a photograph of the car is obtained when passing a given spot at a given time, recording the actual time to the fraction of a second. The shutter speeds give a range of exposures from 1-25 of a second to 1-1,000 of a second, while at the same time and with the same movement a photograph is taken of a watch, thus giving the exact time. A special case is provided for the watch, and in an opening above the latter a card is inserted giving the date, which can be signed by the officer responsible for the time test. Underneath the dial is a numbering apparatus. The case is so made that after the official has placed the watch in the case, it can be sealed up, and it is impossible to tamper with the watch without breaking and destroying the seal. The record thus procured can be referred to at any future time.



Launching a crib in 26 feet of water in the upper rapids where the water is running at 15 miles an hour.

Building the Temporary Cofferdam.



View at junction of the two tunnels at each side of the wheelpit with main tunnel.

Building the Tailrace Tunnel Beneath the River.

ELECTRIC POWER DEVELOPMENTS AT NIAGARA FALLS.—II.

A NEW METHOD OF CONSTRUCTING SANITARY SEWERS.

A strictly sanitary sewer in every sense of the word cannot be built of either brick or vitrified crock. No matter how great pains and care are taken in the construction, there will be more or less seepage, if not at first, then later as the mortar rots with age.

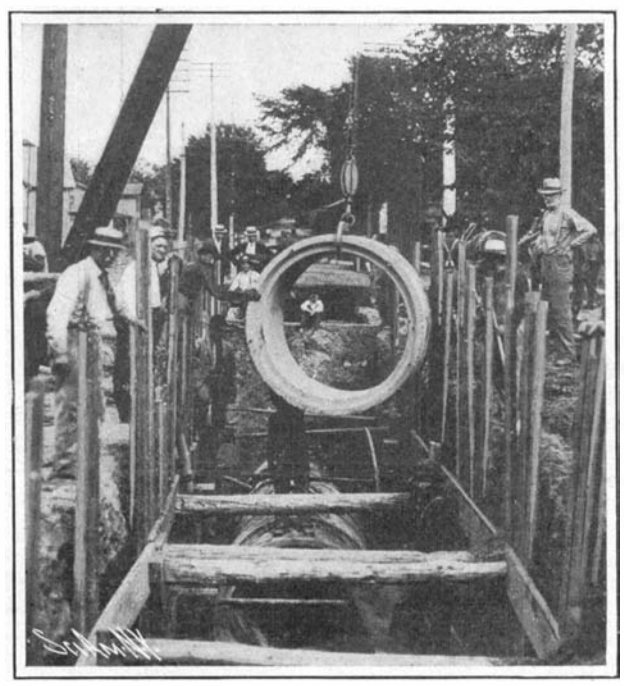
The vitrified pipe sewers cannot be perfectly sanitary, for the reasons that enough cement cannot be inserted in the joints to prevent seepage and the pipe rests on the collars at the joints and either breaks them or loosens the cement, thereby admitting seepage in almost every joint of pipe. Reinforced concrete apparently offers one solution of the problem.

The Jackson Cement Sewer Pipe Company, of Jackson, Mich., have introduced molds and machinery for manufacturing reinforced sanitary concrete sewer pipe that will last for decades without entailing any repairs.

One of our engravings shows the building of a five-foot reinforced concrete sewer at Jackson, Mich., and the lowering of a five-foot pipe into the ditch. This pipe can be made in any size from 15 inches to 10 feet in diameter. The particular feature that appeals to every engineer and experienced sewer builder is the manner in which the joints are coupled together. This is done by an iron band running around each joint of pipe and through the loop of the iron bars, which are imbedded in the cement and pass through the pipe. When this coupling is made the joints are cemented, forming one continuous piece of pipe. The cement adhering to the iron bands makes the joint as strong as any part of the pipe. Seepage is impossible and entirely obviated.

Our other engraving shows a three-foot diameter section of reinforced concrete sewer pipe ninety days old, carrying a weight of 20,000 pounds. This of itself speaks for the enormous strength and durability of the pipe, and removes from the minds of the most skeptical engineers all doubts regarding the practicability of adopting reinforced concrete sewer pipe in the construction of sewers, if they wish to be up to date and give their cities the best there is.

Section of 36-Inch Reinforced Concrete Pipe, 90 Days Old, Carrying Weight of 20,000 Pounds.



A 5-Foot Sewer in Course of Construction, Showing the Lowering of a Section of Reinforced Concrete Pipe into the Ditch.

A NEW METHOD OF CONSTRUCTING SANITARY SEWERS.

Passivity of Metals.

The so-called passive state of metals, in which they remain unattacked, is explained by two different theories. The first of these, which is due to Faraday, Beetz, and others, attributes the passive state to the presence of non-metallic layers of oxides or of gases. The second theory, championed by Schönbein, Berzelius, and Hittorf, explains it by the formation of a surface metallic layer which is in a special state, or "constrained" state of the molecules, corresponding, according to Hittorf, to a higher valence of the metallic ion. A metal is considered in modern times as formed of atoms which are bound by electric charges, either positive or negative. M. W. Müller, a German scientist, in treating the question of the passive state of metals, shows that this fundamental hypothesis is only compatible with the theory of Schönbein as amplified by Hittorf. In consequence, experience shows that all metals which have several valences (iron, chromium, manganese, etc.), that is, which form ions of different valences, may present in certain conditions the phenomena of passivity and activity.

Prevention of Hail Storms. A Review of Recent Experiments.

In Russia, Austria-Hungary, Italy, Switzerland, France, and Spain systematic efforts are being made to prevent the hail storms that ravage the crops, the vineyards, and the gardens. Cannon loaded with gunpowder, sometimes with acetylene, are discharged at the storm cloud; at places in France rockets, bombs, etc., are used. The cannon employed flare at the mouth, blunderbuss-like, and emit a whirling mass of gas, from which detaches itself a sort of wreath of smoke that acts like a true projectile. When the shooting takes place horizontally at a cloud 650 feet or so distant, a sort of "crack" produced by the shock of this gaseous shell is heard. The result of this bombarding, it is claimed, is that the clouds relent to a beneficent rain, or emit snow or *soft* hailstones (like cracked, half-melted ice); the lightning-flashes and thunder-claps grow less frequent, and the storm disperses without having fulfilled its threats, while outside the defended zone havoc reigns.

Though opinion is divided as to whether the favorable results when they occur are caused by the firing, or would have occurred without, many of the farmers, vine-growers, and gardeners believe the former. And M. Violle, the eminent French physicist, who is himself a vineyard-owner, reported very favorably, in February, to the French Academy of Sciences the results of the campaign of 1904 in Beaujolais. M. A. Dastre, writing in the Revue des Deux Mondes (Paris), June 1, 1905, makes some bright suggestions. He thinks the experiment must be extended over a "long series of years" before its success can be considered as established. But the efficacy of the shooting, he says, "will lose its paradoxical or absurd appearance if we reflect on the rôle played by electricity in all these phenomena. We know since Franklin that those phenomena which are spread over the cloud zone are essentially electrical. The tendency to-day is to admit that those which are produced by the hail-preventing (*paragrêles*) cannon have a like character. We may admit, with M. Violle and the other physicists acquainted with the recent acquisitions of science, that the shooting at the clouds does nothing else than re-establish the electrical equilibrium in the sky. The cannon, rockets, and bombs might act upon the electrical condition by means of the warm and ionized gases which they occasion. The hail-preventing implements would then work as veritable lightning-rods operating in the very heart of the clouds. . . . What might be efficacious . . . is neither the concussion of the air, nor its sonorous vibrations, nor the mechanical action of the whirl of gas, nor the shock of the sort of rotatory wreath produced by the detonation. The action would be due to a modification brought into the electrical conductibility of the storm mass; the effect unwittingly realized would be a lightning-rod effect.

"Hail clouds are pretty generally marked by their black hue and the darkness they produce. That is an effect of their thickness (taken vertically) even more than of their structure. This great extension in height, at the same time that it transforms them into opaque screens, involves the existence in their volume of great inequalities of temperature, the high parts being able to be very cold, while the low parts are warm. On the other hand, we know that what afar is a cloud, near by is a mist, i. e., a mass of air studded with little drops of water. Moreover, these drops are full, solid, and no empty bubbles or vesicles comparable to soap bubbles, as was long believed. And if we ask how these drops of water keep up and float without falling, the answer must be given that they do not keep up and that they float only in appearance; that they are falling, in fact, slowly, by reason of their tenuity, as happens to atmospheric dust. The cloud is an organism in evolution; it perishes at the bottom—the little drops vaporizing on contact with the warm lower strata of the atmosphere; and it reforms at the top—this vapor, invisible because genuine gas, reascending to condense again on contact with the cold upper strata. This mass which continually falls and reascends, perishes and reforms, has then but an illusory performance. If our senses showed us the reality, we should see little drops having each one-fortieth of a millimeter diameter, at a distance a hundred times greater (i.e., 2 millimeters) apart, and falling 2 to 3 millimeters [less than one-eighth of an inch] a second. To this first idea must be joined another. A cloud is always electrified, in one way or the other, positively or negatively. Its electrification results from various causes—friction, influence—to which is added, these latter days, the flow of negative electricity produced by the ultra-violet part of the sun's rays. If the little drops of the cloud remain separate and distant from each other, that is in consequence of the electrical repulsion which disperses light bodies charged with electricity of the same name. Let the cloud be discharged in any way, by the warm and ionized gas coming from the hail-preventing cannon, or by contact with a cloud charged contrarily to it, and at once the little drops, just now separate, unite into drops as much bulkier as the discharge shall be quicker and more complete. Thus is explained that rain in big drops, which, in a storm, follows the first flashes of lightning; thus is explained, again, those torrential rains which have frequently been noticed during great battles. . . . This, however, is only rain. To produce hail a further condition is necessary. The cloud must be put in contact with a cooled stratum of air, as are in fact the upper strata of the atmosphere. In that case, its temperature may fall below the freezing point without the cooling at once revealing itself by any apparent sign. The little drops, though very cold, remain liquid. But let any circumstance whatever happen to put these little drops in surfusion in contact with any particle of ice whatever coming from elsewhere; at once they suddenly solidify round that center, and so form that ice-marble which is the hailstone.

"To the conditions of that storm which turns to rain there must, then, in order that there may be hail, be added extensive vertical displacements . . . that shall commingle the warm and low clouds with the atmosphere's upper and cold strata. Now, all storms are characterized by movements of that kind. That is in some sort their definition: a barometric depression determining a violent ascensional movement. One imagines that, if the electric discharge from the clouds is obtained before the mingling movement has reached its whole fullness, the hail will no longer form. Is it in consequence of a premature action of that kind, of a discharge from the clouds, that the hail-preventing cannon act? That is what fresh observations may tell the physicists."

Paper from Furze.

But little paper has been recently made from rags; vegetable substances, such as wood, alfalfa, and straw, are especially employed. But the use of furze, wild or cultivated, has not been thought of until recently. An inventor, says, Le Papier, has ascertained that the furze, suitably treated, produces a very white and solid pulp by the following treatment: 1,000 kilogrammes of the green plant, cut up as fine as possible, are mixed with caustic soda lye of 30 deg. B. and carried to a temperature of 170 deg. C. in an autoclave, under a pressure of 6 kilogrammes. After a boiling of five or six hours, the pulp is washed with water, acidulated with sulphuric acid in suitable quantity, bleached with chloride of lime and washed thoroughly, when it is in a suitable state for employment in the manufacture of paper.

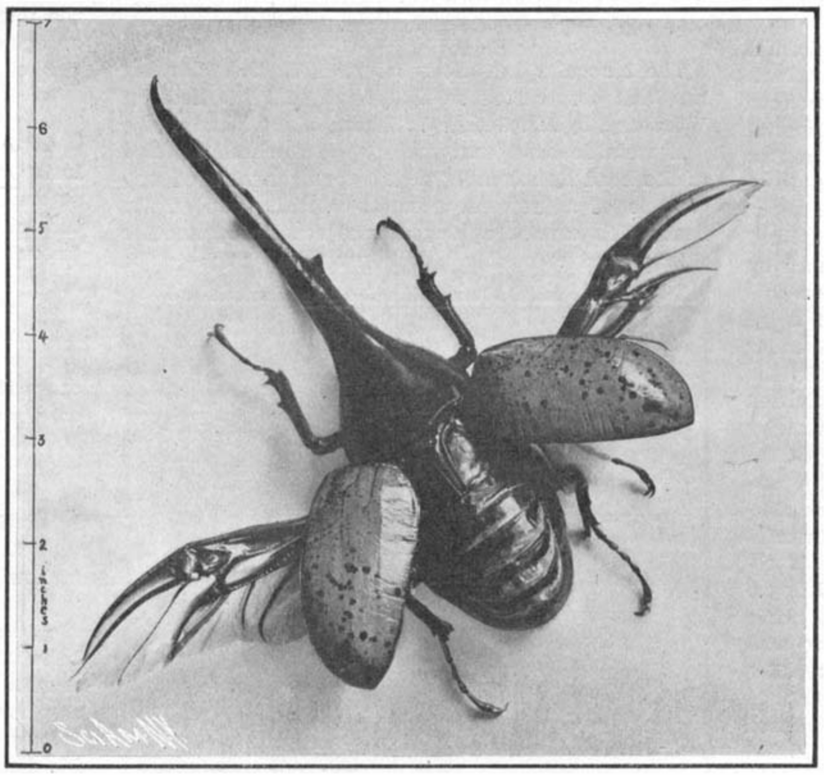
Trials with a new automatic rifle were recently carried out before the officials of the British war department and military and naval officials representing several foreign governments. The weapon is the invention of a Norwegian, Mr. Kallevig, of Christiania. It weighs 8¼ pounds and is sighted to 2,500 meters, and is a slim and compact weapon, the mechanism of which is so designed that dust or grit cannot penetrate it and interfere with its operation. In this rifle five cartridges, either loose or in a clip, are filled into the magazine, and then can be fired in succession, quickly or slowly, without removing the gun from the shoulder. The loading and ejecting are actuated by a small portion of the gas arising from the explosion of the powder. This passes out through a minute hole in the barrel into a cylinder parallel with the barrel, in which works a piston rod which actuates the mechanism. The firing capacity of the weapon is 20 rounds in 30 seconds.

GIANTS OF THE INSECT WORLD.

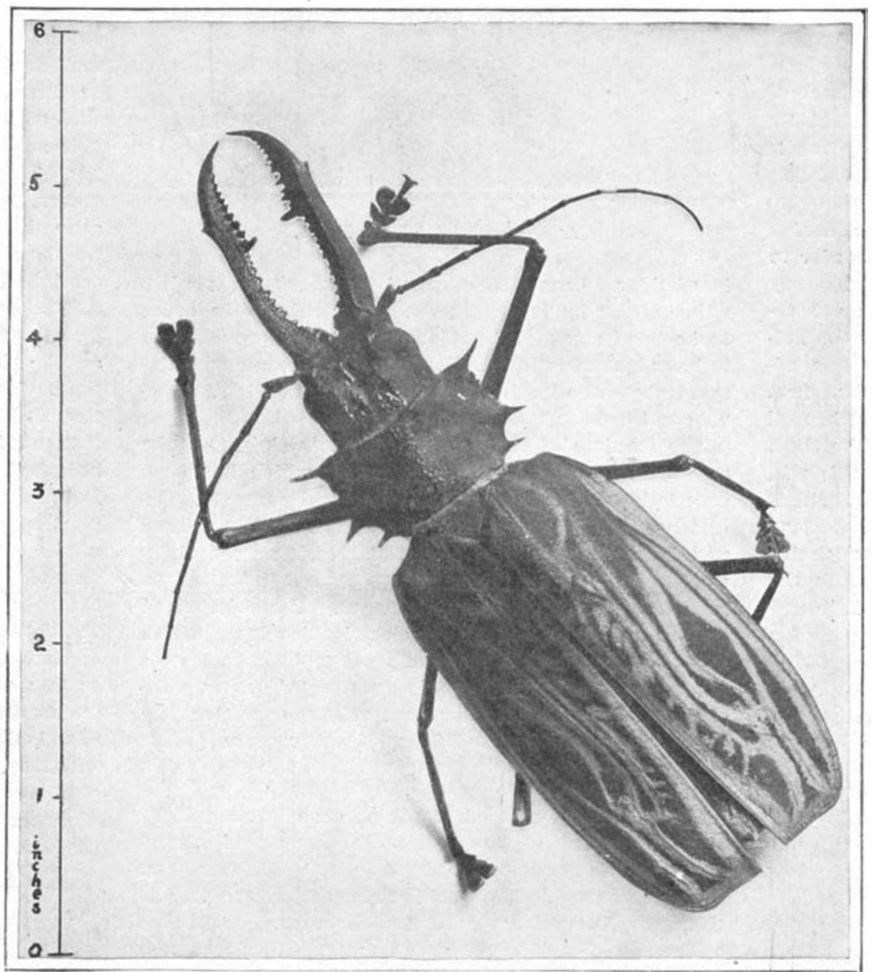
The interesting insects shown in the accompanying illustrations are among the largest known kinds. In fact, the well-known Hercules beetle, shown in the first photograph, is believed to be the greatest existing insect. This is of the *Dynastes*, a genus of lamellicorn beetles of the family *Scarabæidæ*, or typical of a family *Dynastidæ*. It is restricted to forms having the external maxillar lobe with three or four small median teeth, no lateral prothoracic projections and the last tarsal joint arcuate and clubbed. The true type is the *Dynastes Hercules* of the illustration. The length of the specimen is nearly seven inches, of which the curved prothoracic horn is nearly one-half. The spread from tip to tip of the wings is over eight inches. The coloring is a glossy black on the head and jaws, dull green with dark mottlings on the wing-sheaths, and reddish brown on the body. The specimen shown came from the island of Dominica, though it also exists elsewhere in that region.

The third photograph is of a male and female *Megasoma elephas*, of a genus of large cetonian coleopters. They are also of the family *Scarabæidæ*. They are typical of the sub-family *Megasominæ*, having the prosternal process glabrous. This insect is among the largest coleopters known. The male, the larger of the two, is a grayish black, while the female is darker in color. The former is nearly five inches long and two inches broad. The female is smaller, being about three inches in length and an inch and a half broad. They are found in a number of South American countries.

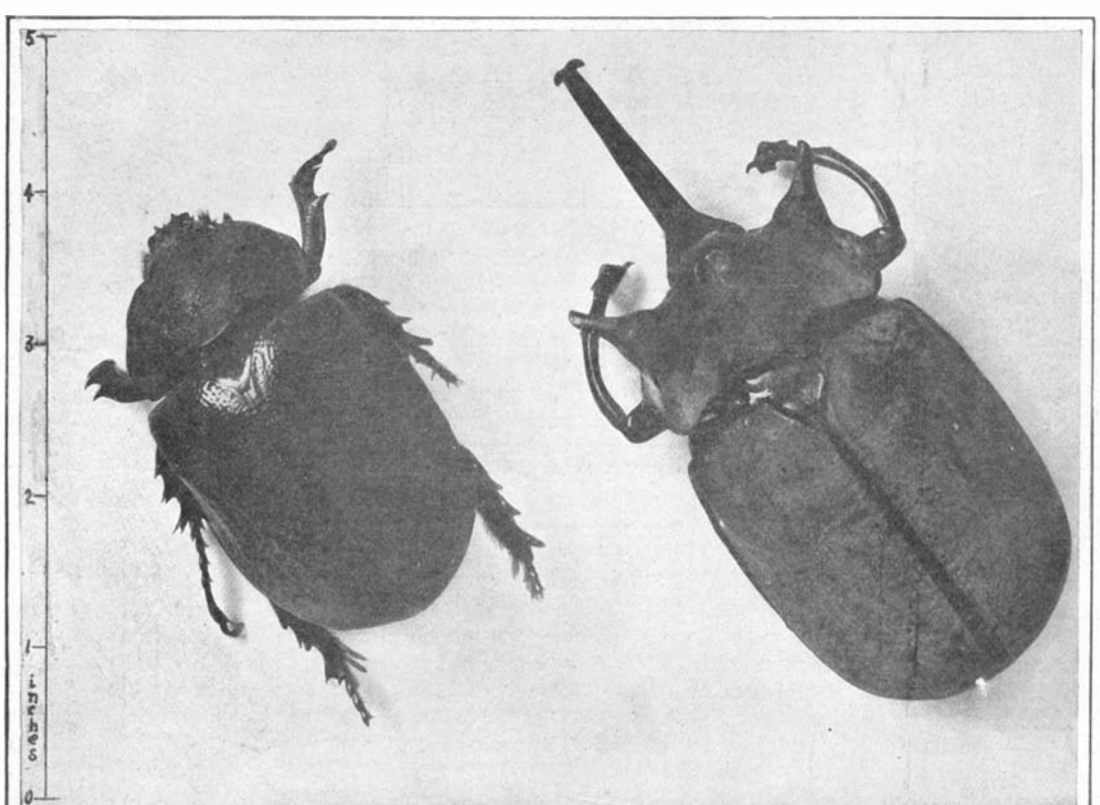
The second insect is a long-horned beetle, the *Macrodontia cervicornis* of the family *Ceramycidæ*. Its length, of which the powerful claws form a considerable part, is nearly six inches. Its coloring is a light cream with reddish brown markings on the wing-sheaths, while the color of the head is a velvety brown. The insect is found in South America, this particular specimen coming from Brazil.



THE HERCULES BEETLE, PROBABLY THE LARGEST KNOWN INSECT



A GREAT BEETLE FROM BRAZIL, THE MACRODONTIA CERVICORNIS.



MALE AND FEMALE MEGASOMA ELEPHAS, GIANT SOUTH AMERICAN INSECTS.

Recent Archæological Discoveries.

A short time ago a company, entitled the Union Electrique, purchased the right to lower the level of the Lac de Chalain (in the Jura, Switzerland) to the extent of about thirty feet. Hardly had the water been drained off to a depth of nine feet when blackened piles began to appear amid the water-weeds. Closer examination showed that these piles formed the plan of a large village, with streets, houses, etc., all complete. Further research brought to light among other things teeth and bones of animals, vegetable and other residue, barley, nuts, needles, apples, pears, flax, coal, half-burnt hearthstones, pottery, wooden pots, tools, weapons, and numerous articles made of horn, bone, wood, and stone. The more interesting finds have been collected and presented to the museum at Lons le Saunier, where they are kept in glass cases. The objects which have attracted the greatest amount of interest, however, are three primitive boats shaped like canoes. The largest one was made from the trunk of a large chestnut tree, and measures 27 feet long by 2½ feet beam and 2 feet draft. The bow of the boat terminates in a kind of spur, while the stern is very similar to that of the modern boat. An opening is also provided in a suitable part of the little vessel, evidently for the reception of a mast. Among the wooden articles found, the following are most worthy of mention: A kind of double-bottomed plate; three small vases, one having a beautifully fashioned handle; soup ladles with carved handles; a bow of yew, and a splendidly preserved yoke for a span of oxen. Among other relics which were discovered we may mention a bear's skull, articles of flint, bones of deer, dogs, horses, beavers, oxen, etc., and portions of human skeletons, the racial characteristics of which have so far not been determined.

To come to a more distant part of the globe, we have a still more interesting discovery to report, a most extraordinary piece of mosaic work having been found in the ruins of the old Roman city of Althiburus, situated in the interior of Tunisia. This city was still inhabited in the seventh century, but was then abandoned, due to Arab invasions, and gradually fell into decay. It was here that two French lieutenants (M. Ordioni and M. Oniam) discovered a beautiful bathing compartment in the ruins of what must at one time have been a fine mansion, and signs of some mosaic work were observed. Excavation was at once commenced, and a considerable amount of fine work was brought to light. The discovery was then examined by M. Gauckler, the famous French archæologist, who has just published a full report regarding the find in the last number of Les Monuments Piot. The mosaic is of a very extraordinary type, representing vessels of all kinds (warships excepted); so far the whole has not been uncovered, but it is believed that the design will be the same in all cases. Each vessel bears its name in Greek and Latin characters, and in some cases an inscription is added from the works of Ennius and Lucilius. In one of the vessels horses are to be seen still marked with their names (Ferox, Icarus, and Cupido); at the side there is written the word "hippago," and a Greek word meaning "horse transport ship"—a type of vessel which was very common in the Attic fleets. Yet another ship is marked "catascopiscus," or the "observation ship," and a man is seen standing and shading his eyes and gazing ahead from the prow. Another boat, entitled "cydarum," contains two fishermen who are seen pulling in their nets. The mosaic also shows a cargo boat loaded with jars containing either wine or oil, and a hunting vessel propelled by rows of oarsmen. It is hoped that the French government will be induced to vote a sum of money for purposes of further excavation, and thus enable one of the most remarkable finds of mosaic work ever known to be more fully brought to light.

Substitute for Caoutchouc.

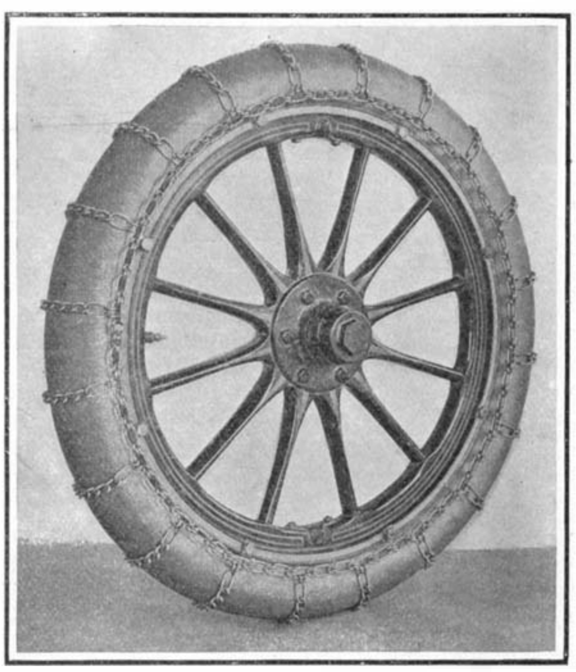
Replying to an article of Witt which appeared in Prometheus, condemning the abuse of substitutes, especially in the caoutchouc industry, in which it is said that the additions of organic and mineral substances are only a method of lowering the price at the expense of the quality, Herr Weber, in the Gummi Zeitung, states that certain additions, as zinc oxide, lime, and magnesia, and sulphides of zinc and of antimony, have a well-determined technical purpose, which it is not possible to supply otherwise. The opinions of Witt on the regeneration of old caoutchouc are inaccurate, both with reference to the product and the method of work. It cannot be applied to restoration of old rubber of good quality, especially to the enormous quantity of old rubber shoes. The regenerated caoutchouc of commerce is considered as an excellent product, permitting of results which cannot be obtained with pure caoutchouc. For the loading, properly so called, Herr Weber considers only the sulphate of baryta and chalk, and will not admit that their employment is an adulteration, since they are added, not to cheapen, but to improve the substance.

Cellulose and Artificial Cotton.

An artificial cotton is now produced in Italy from a cellulose extracted from the fir freed from its bark and knots. The Bulletin of the Chamber of Commerce of Milan describes the apparatus employed. A special machine reduces the fibers to thin pieces of a few millimeters; the wood thus reduced is placed in a large horizontal cylinder capable of containing about 100 cubic meters. The apparatus is of copper lined with lead, and when charged, steam is introduced by means of a pipe at the lower part. This operation continues for ten hours. Then 60 cubic meters of a lye of bisulphate of soda is poured in, and heated under a pressure of three atmospheres for 36 hours. By the boiling the wood becomes white; it is then submitted to a first washing, and grinding by means of a series of strong metallic plates, moved mechanically. After grinding, the matter is submitted to a very free washing, and is bleached with chloride of lime by the electro-chemical method, then pressed between powerful rollers for desiccation. Thus a pure cellulose is obtained, which is reheated in an autoclave containing a mixture of zinc chloride, chlorhydric acid, and nitric acid. A little castor oil, casein, and gelatin are added, in order to give more resistance to the fiber. The pasty mass thus obtained is finally introduced into the receiver, where it is compressed and passed through a drawplate, which reduces it to thread. The thread is passed over gummed canvas, then into a light solution of carbonate of soda, and finally over drying rollers.

A USEFUL CHAIN GRIP FOR AUTOMOBILES.

The photograph reproduced herewith shows a chain device which can be quickly attached to the wheel of an automobile, and which will effectually prevent its slipping or skidding on muddy, greasy, or icy roads, or in deep snow. The chain grip is made up of two circular chains—one on each side of the wheel—connected together by a number of transverse chains which are laid over the tread of the tire. In order to attach one of the grips to a wheel, it is only necessary to lay it carefully upon the tire, and connect together the two ends of each circular chain at the bottom. Suitable protected double hooks giving two adjustments are provided for this purpose. When first put on, the chains should be shortened by cutting off a link or two, if this is found necessary to make them fit tightly. Should they stretch when in use, this will in no wise detract from their effectiveness, nor will it cause them to come off. It is best, however, to have them fit tightly. Even then the transverse chains constantly change their position with respect to the tread of the tire, and so do not tend to wear it in any one place. With these grips there is no danger of a chain breaking and becoming entangled in the driving chains or other parts of a machine. So securely do they hold, that a machine equipped with them was able to ascend a short grass-covered incline of over 45 per cent. They are a necessity for every tourist who wishes to travel with the certainty that he will



WEED DETACHABLE CHAIN GRIP APPLIED TO A PNEUMATIC-TIRED AUTOMOBILE WHEEL.

not be stopped by his wheels slipping around in moist clay, mud, or snow; while for city use they are equally valuable to prevent skidding on greasy asphalt. Their easy attachability makes them all the more useful, as they can be quickly put on when needed and removed when not. The wear on the tires is consequently much less than when non-skidding tires proper are used. The grips are the invention of Mr. H. D. Weed, and are made by the Weed Chain Tire Grip Company, of this city.

A BINOCULAR HEAD LENS.

BY DR. ALFRED GRADENWITZ.

The binocular head lens described in the following has been constructed on the design of Prof. Hess, of Würzburg, by Mr. George V. Schott, of the same city.

A metallic band surrounding the forehead is fixed to the head by means of a thin spring steel band susceptible of adjustment according to the size of the head; this carries a hinged tube containing another thinner and extensible aluminium tube, which is the

A BINOCULAR HEAD LENS.

lens-holder. Lenses of various thickness are readily adjusted for by loosening the upper screw. In order to keep off any side light there has been provided an independent aluminium diaphragm, while a spring located above the lenses serves to receive the lighting device and to keep the same in position.

The freedom of the field of vision is claimed to be an especial advantage of this outfit, which has been especially designed for ophthalmological purposes. The distance of the lenses from the eye is readily altered and the exchangeability of the glasses is an especially good point. As all the parts are made of aluminium, the whole is of an extreme lightness. The object fixed by the eye is lighted by an electric glow-lamp which can be removed at a moment's notice by means of a simple handle. This lamp is constructed for any desired tension and both for accumulator operation and for direct connection to 110 or 220 volt mains.

Discovery of Nova Aquilæ No. 2.

Miss Fleming, who has made a name for herself by her discoveries of new stars, has located a second nova in the constellation Aquila. It was first found August 31 by Miss Fleming, assistant in the Harvard Observatory, who has discovered eight out of the last eleven found in ten years. She was studying the regular list of photographs, including the whole sky and taken every night, when she found a new spectrum. Photographs of August 10 did not show it, but those of August 18 did. At that time it had a magnitude of 6.5, only a little below the light which can be seen with the naked eye. Since then the section of the sky has been followed every night, and it is found that the light is diminishing steadily. This is proof that the star is a new one. It is now of the 11.5 magnitude.

Another Electric High-speed Railway.

The construction of an electrical high-speed railway between Cassel-Cologne is suggested by Mr. Fränkel, a Breslau engineer, with a view to testing on a large scale the possibilities of electrical long-distance railways.

This line, which would shorten the way from Cologne to Berlin by 40 kilometers, would assume a high strategical importance, while serving on the other hand to relieve other lines of part of the passenger traffic.

Assuming a maximum speed of 160 kilometers (99.4 miles) per hour, corresponding with a commercial speed of about 125 kilometers (77.6 miles) per hour, the electrified line, Cologne-Cassel (180 kilometers, or 111.8 miles), would be covered in one hour and twenty-seven minutes, while five hours are required to cover the present line of 275 kilometers (170.8 miles) passing through Elberfeld. These short and light trains would have to be carried on to Berlin by locomotives, with a maximum speed of 100 kilometers (62.1 miles) per hour when the distance from Cassel-Berlin would be covered in four hours and thirty-eight minutes and the total distance, Cologne-Berlin, in about six hours, as against nine hours, which is at present the duration of the journey.

Von Behring and Tuberculosis.

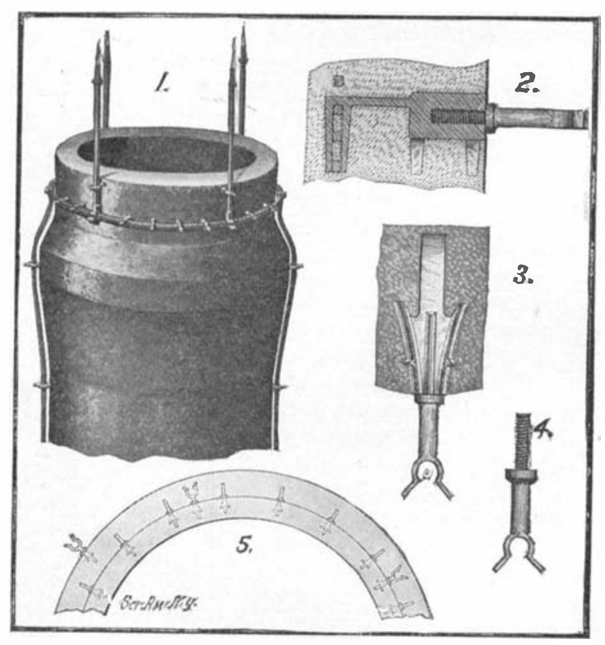
At the closing session of the International Tuberculosis Congress on October 7 Prof. Von Behring made a statement relative to his new curative principle for tuberculosis, which attracted much attention. The professor said:

"In the course of the last two years I recognized with certainty the existence of a curative principle completely different from the anti-toxic principle. This new curative principle plays an essential rôle in the operation of the immunity derived from my bovovaccine, which has proved effective against animal tuberculosis during the last four years. This curative principle reposes upon the impregnation of the living cells of the organism with a substance originating from tuberculose virus, which substance I designate T. C."

Prof. Behring then gave a long technical description of how "T. C." was introduced into the cellular organism, and said it had already given marked results in the treatment of animals. The professor expressed the belief that his researches would show similar curative results in humans. He added that he was unable to say how soon positive results would be shown, but he felt as certain of these results as when he announced his discovery of a new method for treating diphtheria.

ANCHOR AND FASTENER FOR LIGHTNING CONDUCTORS.

Anchor fastening devices for lightning rods have been designed for use on walls built of brick, stone, or concrete blocks, but for structures built of concrete molded at the place into a solid wall, no such provision has heretofore been made, and it has been necessary to drill or break an opening into the wall in order to provide an anchorage for the lightning conductor fastening. This process, aside from the extra labor it involves, not only weakens the wall, but also spoils its general appearance. In the accompanying engraving we show an improved anchor, which is designed to be set into the wall while it is being molded and which will support the fasteners for the lightning conductors. The improved anchor is illustrated clearly in Figs. 2 and 3, which are respectively a side and plan view of the device. In these views the fastener is also shown, threaded into the anchorage. A detail view of the fastener is illustrated in Fig. 4. The anchor, it will be noted, is formed with a number of ribs and projections which will afford intimate contact with the plastic material. Several feet project from the bottom of the anchor, and on these it can rest while the concrete is being poured into the mold around it. At the rear there is an extension, provided with downwardly-projecting flanges which may be brought into contact with the steel reinforcing of the structure, so as to assist the lightning rod by dissipating the electricity through the metallic framework of the building. Fig. 1 shows a side elevation of a chimney provided with the improved anchor and fastener, and a partial plan view of the same is indicated at Fig. 5. A series of anchors are set in a row about the chimney, and the fasteners which are screwed into them support a



ANCHOR AND FASTENER FOR LIGHTNING CONDUCTORS.

wire cable ring which encircles the chimney. At intervals on this cable, the lightning rods are secured and supported by fasteners screwed into anchors at the top of the chimney. Fastened to opposite sides of the cable ring are the conductors which lead to the ground. These conductors are also supported at intervals by the improved fasteners. A patent on this improved anchor and fastening has recently been granted to Mr. Carl Bajohr, 4051 Keokuk Street, St. Louis, Missouri.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

LAMP.—G. KELLER, New York, N. Y. The invention provides an improved lamp for electric lights, gas lights, and the like, arranged to shed a powerful but extremely soft light. This result is accomplished by forming the lamp globe with a chamber in which water or any other desired fluid may be contained, and through which the light must pass.

RAILWAY SIGNALING SYSTEM.—K. SCHOLZ, Liebauthal, near Eger, Bohemia, Austria-Hungary. It is well known that the resistance of a spark gap is materially reduced when ultra-violet rays are caused to shine upon it. Mr. Scholtz makes use of this property in his railway signaling system to prevent both head-on and rear-end collisions. In the latter case the locomotive driver of the first train being signaled to hurry on ahead of the second train.

Of Interest to Farmers.

INSECT-CATCHER.—E. J. KRENEK, Lagrange, Texas. This insect-catcher is a device which may be strapped to the body in such position that it may be readily held under a plant to catch the insects as they are removed. The device contains coal oil, or any other liquid into which the insects will drop, and which will prevent their escape.

CANE-PLANTER.—ANTONIO MARIANI, Yauco, Porto Rico. This invention relates to improvements in machines for planting sugar-cane, the object being to provide a planter of simple and comparatively inexpensive construction by means of which ground excavations for receiving the shoots or lengths of cane may be quickly and evenly made and the dirt covered over the cane.

GUANO-DISTRIBUTER. — F. Q. FOKES, Montezuma, Ga. The purpose of the invention is to provide an attachment for a plow, whereby guano or other fertilizer may be distributed in a uniform manner in the furrow as the furrow is being made. The machine keeps the fertilizing material in constant agitation, and means are provided to regulate at will the supply distributed.

MOWING - MACHINE ATTACHMENT. — O. Z. BALDWIN, Merrickville, N. Y. This mowing machine attachment is adapted to be used in conjunction with the ordinary lift lever of the cutter bar, and consists of means for raising the inner shoe of the cutter bar at any time for the purpose of clearing an obstruction without necessarily interfering with the outer end or outer shoe of the cutter bar, which portion of the bar remains in action.

Of General Interest.

SECURING DEVICE.—G. D. WATSON, Parkersburg, W. Va. Mr. Watson's invention relates to devices for securing or anchoring such elements as the tubes of oil wells, and the like. Its principal objects are to provide a device of this character which may be brought into engagement with or released from the well casing at any position thereon.

PIN-HOOK.—L. E. RUSSELL, Deposit, N. Y. The device is adapted for attachment to a garment, and is especially applicable as an eye-glass hook or holder. Owing to an ingenious design. the device may be constructed from one piece of material, and conveniently applied to a garment without danger of becoming entangled with the fabric.

DRILL-CHUCK.—G. A. ORR, Cripplecreek, Colo. The object of Mr. Orr's invention is to provide an improved arrangement for securing the drill in the chuck without the use of nuts and bolts and similar fastening devices, which are likely to work loose from constant shock and vibration.

LADY'S STOCK-COLLAR.—D. KISCH, New York, N. Y. The collar is so constructed that one section can be separated from the other, and the same section replaced or a similar section substituted, it being possible to connect or disconnect the sections in an expeditious and convenient manner, and to so place the sections that one will appear integral with the other. The section which is close to the neck may be made of washable material, so that the entire collar need not be thrown away when the upper section becomes soiled.

FIFE.—J. JENKS, Mount Auburn, Iowa. The object of this invention is to provide an improved fife arranged to permit the user to quickly and conveniently change the instrument from a B-key fife to a C-key fife, or *vice versa*, and to permit of producing full and loud tones by a proper admission of the air from the air duct of the mouthpiece into the main tube.

Hardware.

ADJUSTABLE-SQUARE.—R. MACD. DIXON, Stockton, Cal. The invention relates to measuring instruments, and its object is to provide an improved adjustable square, which is simple and durable in construction and arranged to permit convenient adjustment of the blade relative to the base, to set the members of the square accurately at a right angle one to the other.

SAW-SWAGE.—C. J. ANDERSON, Eureka, Cal. The device comprises two die cams, which are associated with certain peculiar devices for mounting and operating them, and by means of which the points of the saw teeth may be easily and accurately swaged, drawn out, or flattened to any extent desired, thus making it necessary only to slightly grind the teeth, in order to finish the work of sharpening the saw.

Heating and Lighting.

ACETYLENE-GAS GENERATOR.—E. A. CHAMBERLAIN, Los Angeles, Cal. Mr. Chamberlain's invention is an improvement in that class of acetylene gas generators in which means are provided for automatically regulating the supply of water to the carbide in accordance with the pressure of gas required. There is no liability of overheating the apparatus, and it can be easily and quickly cleaned and recharged with carbide and water.

Household Utilities.

SASH-FASTENER.—G. A. ORR, Cripplecreek, Colo. The invention belongs to that class adapted for use in connection with sliding sashes, and the object is to simplify the construction of such fasteners, and to provide a mechanism which may be operated in a simple manner, so as to hold the sash in an elevated or open position, or in a locked position when closed.

Machines and Mechanical Devices.

ESCAPEMENT FOR TYPE-WRITING MACHINES.—W. WALL, New York, N. Y. The object in view is the provision of an improved mechanism, which is so sensitive in action and in which the friction is minimized to such an extent as to require a light tension on the paper carriage. The mechanism embodies an improved form of escapement wheel, that secures proper clearance of the dogs of this mechanism and controls the paper carriage in an efficient and satisfactory manner.

Railways and Their Accessories.

VALVE.—A. I. PERRY, New York, N. Y. Mr. Perry's invention provides a valve for controlling such fluid-pressure brakes as are used upon street cars. The principal object in view is to afford means for applying the pressure proportionately to the movement of the valve handle.

STATION-INDICATOR. — H. R. NELSON, New York, N. Y. Mr. Nelson's invention comprises a casing which may be placed in a railway car or the like. Within the casing is a roll containing the names of stations along the route. By means of a trip located near each station, the roll is turned to bring the required name in view.

RAILWAY-TIE.—H. S. DELAMERE, Cloverdale, Cal. Mr. Delamere's tie is light and strong, and arranged to permit of expansion and contraction of the track system. It offers ample surface for contact with the ballast to hold it firmly in place. The rails are bolted upon yieldable blocks, so that the vibration resulting from the passage of trains is absorbed thereby. A peculiar shape of bolt head is provided, which is much stronger than the customary flat head.

Pertaining to Vehicles.

RECHARGING-VALVE.—LEONARD F. WILLIAMS, Thurber, Texas. The object of this invention is to permit recharging the auxiliary reservoirs of an automatic air brake system without necessarily involving a release of the brakes. This end is obtained by means of certain ingenious devices.

HAME.—G. B. HOCK, Freeland, Pa. The invention relates to hames for heavy draft harness, and has for its object to provide novel draft attachments for the wooden bodies of a pair of hames that greatly strengthen them, distribute the draft strain equally upon the hames, and facilitate the disconnection of the draft-tug connections from the hames and also the breast-rings therefrom, when their worn-out condition necessitates the replacing of new ones.

VALVULAR MECHANISM.—H. S. AYLING, Bloomington, Ill. A duplex air pump is now commonly employed in connection with fluid-pressure brake systems in which the compressor pistons come to a prolonged rest at the end of each stroke, and in which the inlet valve for the motive steam is held open until the return movement of the piston has begun. This is disadvantageous, for with the inlet valve thus open the steam in the compressor cylinder in time equalizes the boiler pressure, which results in a much higher pressure in the pump cylinder and a greater consumption of steam that is necessary. Mr. Ayling's invention involves a peculiar arrangement of the valves, which causes the steam inlet valve to close as the piston reaches the end of its stroke and the exhaust to be held covered during the time that the piston dwells at the end of its stroke.

Designs.

DESIGN FOR A TABLE.—A. MCKAY, Gretna, La. Mr. McKay has invented a new, original, and ornamental design for a table, which comprises the combination of scrolls and medallions, forming an apron which covers the upper ends of the table legs. The table is thus given a decidedly Oriental appearance.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**
MUNN & CO.

Inquiry No. 7369.—Wanted, name of mill rolling very light steel belting 8 inches to 32 inches wide, and flexible enough to work over pulleys 5 inches diameter.

Inquiry No. 7370.—For manufacturers of non-conducting cement for use in electric heater work to hold resistance wires in place.

Inquiry No. 7371.—For manufacturers of nickel-plated gongs, which are tuned in concert pitch.

Inquiry No. 7372.—Wanted, name of manufacturer who constructed the buckboard automobile.

Inquiry No. 7373.—For partics making electrotypes.

Inquiry No. 7374.—For manufacturers of scales that will weigh and automatically register ice.

Inquiry No. 7375.—Wanted, to buy the plans of a charcoal kiln.

Inquiry No. 7376.—For manufacturers of cleaning machines for Raiz or Rootlets as they are extracted from the soil.

Inquiry No. 7377.—For manufacturers of lawn mowers, having a reciprocating sickle similar to a mowing machine.

Inquiry No. 7378.—For manufacturers of soft iron or soft steel punchings of special make for laminated magnets.

Inquiry No. 7379.—For manufacturers of gasoline irons for tailors and launderers.

Inquiry No. 7380.—For manufacturers of steel tempered for mill picks, same as are used on burr stones.

Inquiry No. 7381.—For manufacturers of stump pullers.

Inquiry No. 7382.—For manufacturers of men's suits, overcoats, hats and caps, shoes, gloves, underwear, etc.

Inquiry No. 7383.—For manufacturers of a mill for grinding raw vegetables to a pulp and extracting the juice therefrom; also machine for grinding and extracting juice from raw meat.

Inquiry No. 7384.—For manufacturers of hydraulic weighing machines.

Inquiry No. 7385.—For manufacturers of traction engines.

Inquiry No. 7386.—For manufacturers of outfits for boys to do electrical experiments with.

Inquiry No. 7387.—Wanted, address of "Gamble Leaf Hinge."

Inquiry No. 7388.—For manufacturers of sand blocking mill for foundry use.

Inquiry No. 7389.—For manufacturers of water wheels.

Inquiry No. 7390.—Wanted, address of manufacturer or inventor of advertising novelty or toy called Fano-Dromo-Tone.

Inquiry No. 7391.—For manufacturers of small metal castings.

Inquiry No. 7392.—For makers of china kilns for firing hand-painted china.

Inquiry No. 7393.—For makers of collodion films for transfer work on china.

Inquiry No. 7394.—For makers of American-Haviland china.

Inquiry No. 7395.—For manufacturers of modern derricks and conveyors for loading and unloading heavy materials, such as long cedar poles, ties, logs from skidway to car; also for handling the materials up inclines from river to piling ground.

Inquiry No. 7396.—For manufacturers of duplicate laths; also tobacco presses.

Inquiry No. 7397.—For manufacturers of black oxide of copper; also caustic potash.

Inquiry No. 7398.—For manufacturers of lightning rods.

Inquiry No. 7399.—Wanted, address of parties doing electro-galvanizing.

Inquiry No. 7400.—For manufacturers of sheet lead, as used for putting up tea and spices.

Inquiry No. 7401.—For manufacturers of the latest cinematograph.

Inquiry No. 7402.—For manufacturers of soft sheet steel to take temper, etc.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(9814) J. H. S. asks: In a great many electrical books and articles on electricity I have noticed the amperage of a certain piece of apparatus is stated, but the voltage is not mentioned at all. How are we to determine the number of watts consumed if the voltage as well as the amperage is not stated? I notice in the "rules and requirements of National Board of Fire Underwriters" they give the carrying capacity of wires in amperes alone. How are we to know whether the capacity they state is for 50 or 220 volts? In field winding we are told so many ampere turns are required per square inch pole face surface for a certain density. How are we to determine the number of turns required if we do not know how many amperes are going to flow over the wire when wound? A. It has been our experience to find both the volts and amperes of a dynamo or motor, or the volts and kilowatts given on the name plate. The carrying capacity of wires is given in amperes because it is amperes which the wires are to carry and not volts. The amperes heat the wires, and not the volts, and the higher the voltage the finer the wire required to carry its current. Hence volts are of no importance to the Fire Underwriters, except to classify the rules for wiring as they do for different voltages. The safety of people from shock depends upon the voltage and not upon the amperes. In the winding of a dynamo the current required to magnetize a field has been determined by the designer, who assumed the amperes and the size of wire to carry them when he determined the size of the magnet cores to give the desired voltage to the machine Hence the ampere turns are known.

(9815) W. C. C. asks: 1. I have a five-bar telephone magneto, which I wish to use for another purpose than that for which it was made. To do this, the amperage must be raised or increased without reducing voltage below 150 volts. Can this be done by reducing resistance of armature, or how? A. You can increase the amperes of your magneto by winding the armature with the same number of wire as at present, but of a coarser size. 2. Will you please tell me where I can purchase tinfoil, with which to make a condenser? A. Tinfoil can be bought from Eimer & Amend, Third Avenue and 18th Street, New York city; or from Patterson, Gottfried & Hunter, 146 Centre Street, New York city. 3. If the above-mentioned magneto giving, say, 1-3 ampere and 500 volts, were connected in parallel with a dry battery, or any other kind, giving $1\frac{1}{2}$ volts and 15 amperes, why would not the output be about 8 amperes and 250 volts on short circuit by striking an average? A. A circuit which has 1-3 ampere at 1,500 volts would have 1,500 ohms resistance by Ohm's law, $R = \frac{E}{C}$. Similarly a circuit with 15 amperes at $1\frac{1}{2}$ volts would have 10 ohms of resistance. Now the rule for divided circuits applies. There is no striking an average in electric currents. To determine what current would flow over the external circuit it is necessary to know its resistance. The resistance of the battery is so low that it would send but little current into the magneto circuit, but the magneto would send its current divided between the battery and the external circuit, sending most of its current through that path which had the least resistance. 4. If a common induction coil giving from $\frac{1}{2}$-inch to 1-inch spark, when excited by a battery, were excited by an electric dynamo giving less than $\frac{1}{2}$ ampere, but high voltage, would there be any output to the induction coil, and how much? A. The high voltage of your dynamo and the low resistance of the primary of the induction coil would cause the dynamo to act as if it were on short circuit and heat the primary of the coil. There would be little output except in heat. We would suggest Swoope's "Practical Electricity," as a good book for one to get hold of the principles of the science so as to be able to judge many conditions and tell what effects would follow such arrangements as you have suggested.

(9816) H. J. M. asks: We have been recommended to you as being able to give us some information in regard to tables of the force of vapor in inches of mercury, weight of vapor per cubic foot of saturated air, weight

per cubic foot of dry air, tables of humidity of air or percentages of full saturation from dry and wet bulb, table of temperature of dew point of different states of hygrometer ranging from 140 to 210 deg. If you are unable to give us the desired information, can you direct us to any one who could do so? A. Nearly all, if not quite all, the tables for aqueous vapor are to be found in the "Smithsonian Physical Tables." Any special figures could always be obtained from the U. S. Weather Bureau, Washington, or from the forecast official at your own city station of the bureau. These officials are always pleased to be able to do a favor to any of the people.

(9817) N. O. J. asks: 1. If a coil gives 1½-inch spark with two Grenet batteries, will it give a 3-inch spark with four Grenet batteries? If the voltage and amperage are doubled in operating a certain coil, will the spark be twice as long? A. Doubling the number of cells in a battery for a coil will not double the spark length, although it will increase the length of the spark. The reason is that the internal resistance of the cells and connecting wires is added to the former resistance of the circuit. This cuts down the current below double the current given by half the battery. Nor will the spark length be doubled by doubling the voltage, if the amperes remain the same. The ampere turns are the measure of the magnetizing power of the primary circuit. Hence the spark length will not be increased except by increasing the amperes. 2. I have a dynamo that has an output of 40 to 50 volts at about 2 to 3 amperes. Is this too high a voltage or too high an amperage for the induction coil described in Supplement No. 160? A. The coil of Supplement No. 160 requires perhaps 3 to 10 amperes at a pressure of 6 to 8 volts. Your dynamo will require an external resistance if you connect it with the coil. Its voltage is too high.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending October 10, 1905

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

ELECTRIC LAUNCH MOTOR. — THE design in this paper is for a motor of unusual simplicity of construction, which can easily be built by an amateur at small cost. It is intended for a boat of about 24 feet over all and 4 feet 6 inches beam, drawing 18 inches, and is capable of propelling such craft at a speed of 7 miles per hour. Illustrated with 21 cuts. See SCIENTIFIC AMERICAN SUPPLEMENT, No. **1202.** Price 10 cents by mail, from this office, and from all newsdealers.

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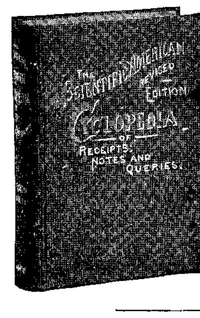

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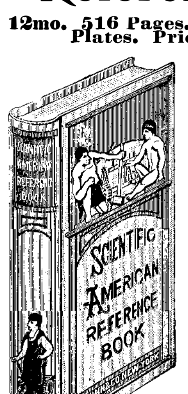

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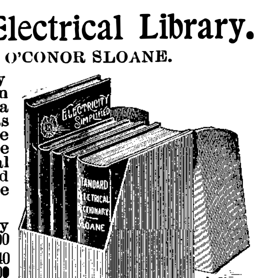

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Suspenders, Common Sense Suspender Co. 46,784
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Syrup, maple, C. D. Cannon 46,824
Teas, Grand Union Tea Co. 46,832
Tonic beverage, Simpson Spring Co. 46,774
Tonics and remedies for heart diseases, cardiac, Sultan Drug Co. 46,866
Varnish and varnish stains, Leggett & Brother 46,770
Wagons or light riding carriages, road, S. R. Bailey & Co. 46,773
Watchcases, Dueber Watch Case Manufacturing Co. 46,874
Watches and watch parts, Hampden Watch Co. 46,867
Whisky, Loeb, Bloom & Co. 46,798
Whisky, Cousins Supply Co. 46,817
Whisky, Albert M. Gugenheim Co. 46,819
Whisky, Freiberg & Workum 46,830
Whisky, M. Shaughnessy Distilling Co. 46,841
Whisky, V. J. McQuade 46,842
Whisky, E. Schiele & Co. 46,858
Whisky, Sunset Distilling Co. 46,865
Whisky, Bergin & Brady Co. 46,869
Whisky, Commercial Distilling Co. 46,872
Whisky, Baer Bros. Mer. Co. 46,888
Yarns, worsted and cotton, Arlington Mills. 46,838

LABELS

"An Oven Full of Ginger Snaps," for ginger snaps, Pennsylvania Baking Co. 12,390
"Best Yet," for syrup, Goyer Alliance Refining Co. 12,288
"Fly Nets," for fly nets, Milwaukee Net Co. 12,391
"Gold Nugget," for syrup, Goyer Alliance Refining Co. 12,387
"Wheat Fibre," for breakfast food, W. E. Williams 12,389

PRINTS.

"Imperial Hats 1905-6," for hats, Samuel Mundheim Co. 1,434
"Life's worth living in torrid weather if one has Wiedemanns," for beer, Geo. Wiedemann Brewing Co. 1,429
"Robin Hood's Christmas," for beer, Geo. Wiedemann Brewing Co. 1,430
"Slices of Energy," for flour, Washburn-Crosby Co. 1,433
"Sweethearts and Wives and It's Wiedeman's," for beer, Geo. Wiedemann Brewing Co. 1,431
"The Best That Money Can Buy," for malt extracts, Wilmann's Bros. Co. 1,432

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., 361 Broadway, New York.

Canadian patents may now be obtained by the inventors for any of the inventions named in the foregoing list. For terms and further particulars address Munn & Co., 361 Broadway, New York.

THE CITY OF NEW YORK

Department of Street Cleaning

NEW YORK, September 2, 1905.

Contract for the Final Disposition of Garbage in the Borough of Manhattan, for Five (5) Years, from August 1, 1906.

Bids for the above contract will be received at the Main Office of the Department of Street Cleaning, Nos. 13-21 Park Row (14th floor), Borough of Manhattan, until 12 o'clock, noon, Monday, November 6, 1905.

For further information as to the nature of the work and the manner and requirement of the bids, bidders should call upon the Commissioner of Street Cleaning, and should also read the advertisement of said contract now appearing in the **"City Record."**

JOHN McG. WOODBURY
Commissioner of Street Cleaning